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P R E F A C E.

A REPORT on Plague in India from September 1896 to August 1897, compiled by Mr. R. Nathan, I C. S., was published under the orders of the Government of India in 1898, and a report on Plague in this Presidency for the same period, compiled by Mr. Couchman, I. C. S., was published under the orders of this Government in September 1897. Subsequently, neither the Government of India nor this Government have issued any comprehensive report on Plague, but reports have been issued by other Governments in whose territories the pestilence has appeared. They are as follows—

- (1) Report on Plague in the Hoshiarpur and Jullundar Districts (Paujab).
- (2) Report on Plague in the Central Provinces.

The Government of Bombay have decided that it is desirable, if not indeed necessary, that some account of the history and progress of Plague in this Presidency during the past two years, together with the efforts made to repel and to combat it, should be placed on record. The main objects aimed at in this Report are—a comprehensive record of the rise and progress of the disease in this Presidency from May 1897 to June 1899, with its effects, both good and bad; the delimitation of our present knowledge of its origin, growth, dissemination and treatment; the results attained by the preventive and combative measures actually adopted; and a work of reference.

The sources from which this Report has been compiled are many and various. They may be summarised briefly as follows.—Reports of other Governments, reports of Government officials, and others specially employed on Plague duty; reports of specialists and experts, miscellaneous works on Plague. In this connection special acknowledgment is due to Major W. B. Bannerman, I. M. S., and Capt. C. J. R. Milne, I. M. S.,—to the first of whom is due a large share in the Chapters on Inoculation and the Rise of the Plague Research Laboratory, and also the revision of the Chapter on the Medical Aspects of Plague, and by the second of whom the Chapter on the Bacteriology of Plague was specially written for this work to Mr. E. Sands, late Superintendent of the Plague Department, whose great experience of Plague records, and whose help in the correction of proofs, and in suggestions regarding the Report generally, have been most valuable to Major J. Cramm, V. C., I. M. S., and to Dr. E. L. Marsh for much miscellaneous assistance.

An Index, carefully and methodically compiled, by Dr. Cuthbert Christy, on Special Plague Duty, has been added for facility of reference.

Executive Plague duties have, unfortunately, seriously interfered with the up-keep of accurate and detailed Plague records. Plague appears in a place, sweeps off anything from one-tenth to one-third of the population in a few months, and then disappears, leaving no time for the Plague staff to do more than attend to the wants of the stricken and provide for the protection of the healthy. Records kept under such conditions as these, where a continued series of close observations concentrated on one particular point have been impossible, preclude any but the most hesitating deductions.

It has been considered better to insert charts, maps, etc., in their proper places, than to collect them in a separate volume.

The period properly embraced by this Report is from 4th June 1897 to 2nd June 1899, and events outside these dates are very briefly dealt with. For details of the first year's Plague and Plague measures, therefore, Nathan's or Couchman's Reports should be referred to.

For those whose interest in the subject of Plague extends beyond the limits of this volume, a Chapter—though by no means an exhaustive one—on Plague Literature has been added.

Bombay,
30th November 1899.

J. K. CONDON, CAPT.,
Indian Staff Corps,
Under-Secretary to Government.

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INTRODUCTION.

[The following are the sources from which this chapter has been compiled:—

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MacLean, *Epidemic and Pestilential Diseases*. Nathau, *The Plague in India Bombay Gazetteer*]

The word *plague* is derived, through the Latin *plaga*, from the Greek $\pi\lambda\eta\gamma\eta$: it signifies 'a stroke.'

Plague is the most deadly of all known diseases. Obscure in its origin, persistent in its duration, terrible in its effects, it has baffled alike the investigations of science and the observations of the most perspicacious. The attitude it compels in those who are, and in those likely to become, its victims is one of abject panic. It assumes varying forms, it strikes with varying force, it rises and falls with varying rapidity.

Such is the disease which, appearing century after century, now in the most deadly epidemic, and now in a mild sporadic, form, was the scourge of Europe up to the very beginning of the 19th century. As well for the sake of completeness, as for that of interest and comparison, a brief sketch of what it has done in the past both in the West and in the East, will not be out of place here.

PLAGUE IN EUROPE.

(A. D. 542—A. D. 1841.)

Previous to
A. D. 1300

The first historical notice we have of Plague is contained in the fragment of the Physician Rufus of Ephesus, preserved by Oribasius (*circa* B. C. 200); but although mentioned later by Livy and by Orosius as destroying one million people in Africa, it is not until the 6th century, in the reign of Justinian, that we find Bubonic Plague in Europe.

Beginning at Palusium (Egypt) in 542 A. D., it spread over Egypt; in 543 it reached Constantinople, where it is said to have destroyed 10,000 people in one day; in 546 we find it in Gaul (France); in 565 in Italy, "where it depopulated the country to such an extent as to leave it an easy prey to the Lombards." Constantinople was, thus, we see, the first haunt of Plague in Europe; and it appears to have been the starting point for most, if not all, succeeding European epidemics.

But although Plague appeared thus early in Europe, it was not until very much later that it appeared in England.

The history of Plague from the time of the Justinian pandemic is very vague until we reach the 14th century, when that great cycle of epidemics known as the "Black Death," swept over Europe, inflicting enormous mortality * . . .

* "Whether in all the pestilences known by this name the disease was really the same may admit of doubt, but it is clear that in some at least it was the bubonic plague."—*Encyc Brit*, Art 'Plague'

"It must, however, be remembered that although numerous pestilences in Europe are recorded by mediæval chroniclers, there is no sufficient evidence, before the 14th century, that they were bubonic plague. The undoubted prevalence of this disease began after the black death of the fourteenth century."—*Quain's Dict. of Med.*, Art 'Plague.'

14th Century.
"The
Black Death"

This frightful scourge appears to have originated in the East, and to have entered Europe *via* Tartary and the Crimea. According to old Russian chronicles, its origin was China, where, as is confirmed to some extent by Chinese records, pestilence and inundations are at this time (1300-1400) said to have destroyed the enormous number of thirteen millions. Appearing first in Sicily and Constantinople in 1346, it invaded Greece, parts of Italy, and Marseilles in 1347; in 1348 it attacked Spain, Northern Italy and Rome, Eastern Germany, many parts of France, including Paris, and England, including London, whence it spread to Scandinavia. Oxford was attacked in 1352. Scotland and Ireland, too, though affected later, did not escape.

The death-tribute exacted by this terrific wave of pestilence was appalling. It is estimated that three-fourths of the population of England perished* ; while Europe is calculated to have lost one-fourth of its inhabitants—*twenty-five millions of people.* †

15th Century.

In the 15th century the pestilence re-appeared frequently in almost every part of Europe : carrying off 80,000 in Dantzic and the neighbourhood in 1422, 40,000 in Paris in 1466 : while Northern Italy was devastated in 1477-85, at Brussels in 1485. In the last year of the century (1499-1500) a severe plague in London caused King Henry VII. to retire to Calais.

16th Century.

The 16th century was not more free from the scourge than the 15th ; but it constitutes an important epoch in Plague : for, about 1550 A. D., *the question of contagion was first raised.* Plague had also henceforth to be distinguished from Typhus fever, which, during this century, made its first appearance in Europe.

Edinburgh was attacked in 1529 : London and the north of England in 1537 and 1547 : Italy and Germany about the same time ; while in Paris about this time plague was an every-day occurrence, familiarity with which had bred contempt. Severe epidemics occurred at Moscow and in the neighbourhood (1570), in which 200,000 perished ; at Lyons (1570), plague mortality—50,000 ; at Venice (1576), where 70,000 were carried off.

17th Century

In the first half of the 17th century the pestilence was still prevalent in Europe, though considerably less so than in the Middle Ages : in the second half a still greater decrease took place. while in the next 25 years it was disappearing rapidly from Western Europe.

Two noteworthy epidemics, nevertheless, were recorded during this century. The first—one of the most terrible and destructive of all recorded European epidemics—raged at Naples in 1656 : where it destroyed 300,000 people in 5 months. Genoa also lost 60,000 in this epidemic.

* "In England a great part of the country remained untilled, and the deficiency of labourers was such as to cause a sudden rise of wages, which, in spite of attempts to check it by legislation, is believed to have effected the final emancipation of the labouring class. On the other hand, a great transfer of property to the Church took place—with what results is well known"—*Encyc. Brit.*, Art. "Plague."

† Becker's estimate.

The second was the great Plague of London; in which, out of an estimated population of 500,000 (two-thirds of whom are supposed to have fled panic-stricken), 68,000 perished within the year.*

From 1666 England was free from Plague. A few sporadic cases indeed occurred up to 1679, and a column filled up with "0" is found in the bills of mortality up till 1703; when it finally disappeared. For its disappearance from England now (1679), as for its disappearance from the Continent of Europe later, no reason can be assigned.

18th Century. In the 18th century Plague was more or less confined to Eastern Europe, although in 1720-1722 a severe outbreak occurred in Provence; Marseilles and Toulon being attacked. In this outbreak, out of a total population of 250,000, 87,500 are said to have perished. The Provence epidemic is noteworthy because of the panic it caused in England: *where in consequence quarantine was enforced for the first time.* In 1717 Plague re-appeared at Constantinople: 1719 in Transylvania, Hungary and Poland: 1743 in Sicily: 1738-1744 in Hungary, Moravia and Austria: 1755 in European Turkey: 1770 in Moldavia (during the Russo-Turkish War), Poland, Kieff, and Moscow, at which latter place it developed into one of the most destructive epidemics of modern times. Over 50,000 persons—nearly one half of the population—perished. From 1770 the disease, while re-appearing in the haunts of the terrible early epidemics, was more limited both in range and duration. In 1799 and 1800 a new epidemic in Syria and Egypt affected both the French and the English Armies which were operating there

19th Century.

Throughout the 18th century the tide of Plague had steadily ebbed away from the West; in the 19th century this ebb was still more marked. In 1802 Plague appeared at Constantinople and Armenia: in 1806 at Astrakhan (Russia). in 1808 at Smyrna. In 1812 a more general epidemic affected these places and also Egypt. From 1813-1815 it appeared in Bucharest, Malta, Corfu, Dalmatia and Egypt: in 1815 at Noja on the East Coast of Italy—so far its last appearance in that country—and produced a panic throughout Europe. In 1824 it attacked Tutchkoff in Bessarabia, but the town was strictly isolated by a military Cordon, and the disease did not spread. In 1828 it appeared in Cronstadt, and is believed to have been again confined by similar action. In 1828-9, during the campaign of the Russian Army against Turkey, a more serious outbreak occurred: for Plague appeared in Odessa, the Crimea, Moldavia, Wallachia, and Bessarabia; but it spread no further; its limitation being again attributed to the Russian and Austrian military Cordons. In 1831 Constantinople and Roumeha suffered from Plague; in 1837 Roumelia and Odessa; and, with an isolated outbreak in Dalmatia in 1840, and one in Constantinople in 1841, the Plague-History of the European Continent comes to a close.

* "This number is likely to be rather too low than too high, since, of the 6,432 deaths from spotted fever, many were probably really from plague, though not declared so to avoid painful restrictions."—*Encyc. Brit.*, Art. "Plague."

With such a previous record, the recent appearance of Plague in Portugal and Spain cannot be regarded without anxiety.

At the present time there are believed to be three endemic haunts of plague. The first in Mesopotamia ; the second in Gahrwal and Kumaon at the foot of the Himalayas in the North-West Provinces : the third in Yunnan in China.

Dr. Koch mentions another endemic centre, which is situated in Africa (near lake Nyassa), and is supported in this view by Dr. Proust.

PLAGUE IN INDIA.

(Up to September 1896)

Before
1800 A. D.

We cannot in the case of India trace the history of Plague century by century. Up to 1800 a reliable historical document is a *rara avis*. We can only record the instances where mention is made of Plague under such terms as 'Waba,' 'Ta'un,' etc., and conjecture how far the statements are accurate, and to what extent the pestilence referred to is identical with that which is amongst us now. But even such references as these are rare. The following brief summary of what is known on the subject is taken from Nathan's *Plague in India*

"Only two direct references have, however, been traced which may point to the existence of Plague in the west of India in the fourteenth and fifteenth centuries. The first is from Ibn Batuta, who notices that Muhammad Tughlak's army in Ma'bar (1325-1351) mostly perished of pestilence, and that at the end of the century (1399), after Timur left, the districts through which he had passed were visited by pestilence. The second relates to the year 1443, when pestilence caused such loss of life in the army of Sultan Ahmad I. that, leaving many of the dead unburied, he retired to Gujarat. Ferishta calls this disease *ta'un*, and speaks of it as very unusual in India. The famine of 1590 to 1594 was followed by a pestilence that, besides hamlets and villages, depopulated whole cities. It must remain a matter of conjecture whether these outbreaks of virulent pestilence were epidemics of true Plague

"Twice in the seventeenth century the district of Ahmedabad in the Bombay Presidency was visited by severe epidemics of pestilence which were probably outbreaks of Plague. The *Bombay Gazetteer* gives the following description of the first of these epidemics, which appears to have been very widespread :—

"The disease that raged in Ahmedabad in 1618 began in the Punjab in 1611. It is called the plague, *Waba* or *Waba-o-ta'un*, and the works of the Hindus are said to have no mention of such a disease. It was thought to be connected with the comet of 1612. From the Punjab it spread through Lahore, through the Doab to Delhi, and north to Kashmir. No place in Hindustan was free from its ravages. Lulling at times, it continued to lay waste the country for eight years. About the same time in Kandahar the land was overrun by mice, and mice and plague seem to have had some close connexion. A mouse would rush out of its hole as if

mad, and striking itself against the doors and walls of the house, would die. Then the plague was in the house. If the people at once fled they might be saved; if they stayed, the whole village was swept away.'

"With reference to the second outbreak which occurred during the period 1683 to 1689, the *Gazetteer* makes the following remarks: 'For several years before 1689 the plague, *Tá'un* and *Wabá*, was again in Ahmedabad, and lasted for seven or eight years. The visible marks were swellings as big as a grape or banana behind the ears, under the arms, and in the groin, and redness round the pupils of the eyes.' Hirsch repeats the following quotation made by Macpherson ('Annals of Cholera,' London, 1872) from an Indian chronicle which apparently refers to this epidemic: 'A fever had prevailed for some years both in the Deccan and in Gujarat. It consisted of a slight swelling under the ears, or in the armpit or groin, attended with inflamed eyes and severe fever. It generally proved fatal in a few hours.' Hirsch remarks that this description is suggestive of plague.

"It is stated in the *Ahmedabad Gazetteer* that during the eighteenth century, though none of the symptoms of the disease are described, there would seem to have been several outbreaks of a most deadly form of fever. In 1718, a year of famine, great numbers died of sickness; in 1770, another famine year, 'on account of the unwholesomeness of the atmosphere, thousands of people died of fever in two or three days, so that no one could be found to bury them.' Fearful disease is said to have accompanied the 1790 famine."

The
Gujarat Epidemic,
1812-1821.

From the year 1800, however, the sources of information are reliable, and we have authentic records of at least two great epidemics. The first of these was the Gujarat epidemic of 1812-1821.

Breaking out first in Cutch in 1812, and spreading thence over Kathiawar, Ahmedabad, and Southern Sind, it devastated Western India for a period of ten years. The years 1811 and 1812 were remarkable for a severe famine which affected the larger portion of Gujarat. It was at the close of this famine that the Plague appeared in Cutch.

Cutch is said to have lost half its population during this epidemic. Two Medical Officers, Drs. Gilder and White, visited the country at the time, and wrote accounts of the disease: *and the pneumonic form of plague was now discovered for the first time by Dr. White, who gives the following interesting description of its symptoms:—*

The first notice
of pneumonic
plague.

"In this man the heat of the body was not much increased nor the pulse
"greatly accelerated; his bowels were not disordered, nor did his tongue
"indicate much febrile irritation. He was able to walk about and converse,
"answering questions distinctly. No person would have thought him in
"danger, but there existed in the patient's mind a degree of alarm and
"anxiety altogether disproportionate to the apparent symptoms. He had

“only been attacked that morning. All his consideration seemed absorbed with a pain in his chest. He answered to my questions whether he had not other pain, as in his head, his back or limbs, that these were slightly painful; but he immediately recurred to his chest, dwelling upon that with a look of most painful distress; and if not questioned about other symptoms, it seemed as if he would not have mentioned them. He had besides a very slight cough—so light that it might easily have escaped unnoticed—and this was accompanied with a discharge of blood from the mouth. The following day he was delirious, had a burning skin, with a very quick pulse. I searched for, but found no buboes. He died in the course of the succeeding night, *i.e.*, in less than forty-eight hours from the first attack. The characteristic symptoms of this variety are, slight cough, pain of the chest, and hæmorrhage from the mouth, attended with fever, but no buboes.”

**Mild Bubonic
Plague.**

Dr. White also observed a “mild bubonic type,” which he describes as follows:—

“I saw,” he states, “a great number who had buboes without any fever, and was told that upwards of one hundred and twenty had suffered in this way. These people walked about without either alarm or inconvenience, for none had died, and not many of the buboes suppurated.”

Quain also records a similar form*:—

“In 1877 an outbreak occurred at Resht, the capital of the province of Ghilan, Persia, and in the surrounding district. Ghilan lies at the south-west angle of the Caspian Sea. The same year cases of a fatal bubonic febrile malady occurred in the District of Baku on the Caspian shore of Trans-Caucasia: and an outbreak of a non-fatal bubonic affection took place in Astrakhan and its vicinage, since recognized as a form of plague.”

It is interesting to note that the same form occurred in Cutch last year, and is thus described by the Political Agent, Major Hyde Cates †.—

“During the last three months of the year under report (*i.e.*, March, April, and May 1899), several cases have occurred in which there has been a bubo (generally in one of the arm-pits), but without fever. The person attacked has suffered from headache for a day or two, but has not otherwise been inconvenienced.”

**The Pali
Epidemic
1828-1829.**

The second epidemic was the Pali outbreak of 1828-29; although a disease suspiciously akin to plague was discovered by Col. Skinner at Hansi (Punjab) in 1828-29.

The Pali outbreak occurred in the District of Merwara, between the State of Jodhpore on the north, and the State of Udaipur on the south. Breaking out in July 1828 at Pali, a large town in Marwar, where it destroyed some 4,000 people,

* Quain's *Dict. of Med.*, Art. “Plague.”

† Cutch Political Agent's Report No. 339 of 24th July 1899.

it spread to Sujat (population, 6,000) and Jodhpur (capital of Marwar), affecting all the intervening towns and villages. From June to March 1837, it attacked the villages of Dewair, Deoghar, Lucanthana, Bednore, Jaha and Ranghar (Ajmere). In April 1837 it spread in the direction of Neemuch Cantonment, two villages in Merwar being attacked. Towards the end of 1837 it again appeared in Pali and did not die out until the Spring of 1838. The total mortality of this epidemic is not known with any certainty; but it is estimated that 100,000 Marwaris perished. Apart from these great epidemics which have occasionally visited India, and apparently unconnected with them, there is an epidemic centre of plague at Gharwal and Kumaun at the foot of the Himalayas. These two Districts, situated in the North-West Provinces, with an area of over 11,000 square miles, contain a population of nearly 1,000,000 persons. The disease is here called *mahamari*; but Assistant Surgeons Francis and Pearson, who investigated the disease locally in 1852, arrived at the following conclusions:—

- (1) Mahamari and Plague are identical.
- (2) Mahamari is of local origin: capable of transmission from person to person and place to place.
- (3) That it is gradually extending itself, and that there seems no reason why it should not be developed in the surrounding country.

A little more detail as regards former epidemics in Districts in this Presidency is given in the chapters devoted to the recent outbreaks of Plague in such Districts; but for full details, "Nathan's Plague in India," 1896-97, Vol. I., should be consulted.

APPENDIX A (to Capt Childe's Report).

On the Clinical Aspect of Plague-Pneumonia.

When plague appeared in Bombay, and as the disease developed, one was struck by the following facts.—First, in all published accounts of the disease, although the ordinary phase of the malady, *viz*, plague with buboes, is principally described, still mention is always made of another and more fatal form without buboes; whereas, here in Bombay it seemed as if the bubonic form were alone appearing, for, at the beginning, one saw no examples of the other form. Then one observed that coincidently with the increased death-rate due to plague, there was a large and unexplained increase assigned to remittent fever and respiratory diseases. Week by week, as the plague mortality increased, so did that under these two headings, and though it was possible that all these were cases of known but concealed plague, still one could not help suspecting that some of them might be due to plague which was not diagnosed because of the absence of buboes. So I resolved to examine the bodies of all hospital patients who had died of fever, pneumonia or any acute illness, to see if there were evidence that any of them had really died of plague. And at the end of December I met with a case which had been diagnosed as broncho-pneumonia, but which turned out to be one of plague affecting the lungs, without causing any marked enlargement of the lymphatic glands—a case, in fact, of plague-pneumonia, and its *post-mortem* was exactly like many others that I have since made, typical of the disease, and I will give a few notes of it

B L., Hindu, male, 25 years old, admitted for fever and cough, December 26th, 1896, under Dr. S. He said he had been ill for about seven days. He had symptoms in the chest which led to the diagnosis of broncho-pneumonia being made. No lymphatic glands were found to be enlarged or painful, and a specimen of blood taken by Dr. S shewed no plague-bacilli under the microscope. He coughed up about two ounces of blood-stained fluid on the night of the 27th, and died at 3 A.M. on December 28th.

Post-mortem on December 28th, seven hours after death

Lungs—Much general engorgement and cedema, with sero-sanguineous frothy fluid in the bronchi, but no pus; and the usual appearances of acute bronchitis were absent. There was one small pneumonic patch, the size of a walnut, in the early second stage, situated a little below the apex on the front of the right lung, and two similar but smaller patches at about the same part of the left lung. These patches stood out a little from the surface and were light grey in colour, airless, friable and sank in water, and each was surrounded by a dark ring of engorged lung in the first stage of pneumonia, which merged into healthy lung, there was some recent pleurisy over the pneumonic areas. All the other organs were examined and showed considerable engorgement, but no special lesion was observed.

Condition of the Lymphatic Glands.—The bronchial were quite small and of normal appearance, the cervical were slightly enlarged, but pale and not engorged, the axillary were pink and slightly enlarged; the left iliac were somewhat large, red and soft, the lumbar were swollen but pale; and all the other glands looked absolutely normal.

Cultures were made on agar-agar from the pneumonic lung and spleen, and ultimately a pure growth of the plague-bacillus was obtained from each.

Microscope.—The pneumonic patches in both stages showed an immense number of plague-bacilli, and the rest of the lung showed a large number; the left supra-trochlear and the left femoral glands shewed a fair number, and all the other glands extremely few; the spleen and blood also showed a few.

So this was a case of plague, in which during life all the symptoms pointed to disease of the lungs, and in which there were no evidences of glandular enlargement, whilst after death there was clear proof of enormous growth of plague-bacilli in the lungs, and of only very slight growth in the lymphatic glands.

I have made up to the present twelve *post-mortems* on such cases, all presenting appearances similar to the above, and I may add, that all the patients were brought to hospital by their friends, supposed to be suffering from cough and fever, and, as far as I know, they were quite unaware of the nature of the disease. I have also to say that in nearly all the other cases the fluid from the trachea or bronchial tubes has also been examined, it shows an immense number of plague-bacilli, and cultures of plague can always be obtained from it

With regard to the clinical symptoms of these cases, it fell to me to attend on the late Dr Manser, and as he died of this form of plague, I will mention a few facts about his case. He was in his usual health on January 2nd, and had a sudden rigor in the morning and felt fever coming on. During the day a bad headache developed, he felt nausea and vomited several times, and he had pains and a tired feeling in his limbs; his tongue remained clean and moist, and his skin was slightly moist. At 2 P.M., temperature 103.4, pulse 116, respiration 25, and there were but slight variations during the day. On January 3rd, had passed a bad night and felt worse, and all the symptoms persisted, except the aching in the limbs, and he felt very ill. The temperature remained between 103.5 and 104.5, pulse about 110, and respirations about 23 throughout the day. During the afternoon he felt some pain at the lower part of the left axilla, just under the anterior fold, but there was no glandular enlargement or pain in the glands anywhere. On January 4th, had passed a bad night and felt very ill, temperature 104.6, pulse 118, respiration 25, tongue still moist, with a little fur behind, and no sordes about the lips or teeth, the other symptoms as before. During the night he began to cough and brought up some watery sero-mucous fluid, slightly blood-tinged, and the pain remained in the same place, only more diffused now, being felt over an area of a square inch. At this part some moist sounds could be heard like those of early pneumonia, and they could also be heard just below the left clavicle, the rest of the lungs and other organs appeared to be normal, as did the lymphatic glands. Patient considered that he had pneumonia, but the symptoms were not like ordinary pneumonia. For the onset was different, the condition of the tongue and mouth different, there was no dyspnoea or pneumonic disproportion of pulse and respiration, and the sputum was not at all like rusty sputum, for it was loose and free, coming up with the slightest cough, it was watery, looking more like serum than mucus, and it was slightly pink, not rusty yellow at all. Also there was the striking fact that the patient's general condition was far worse than could be explained by the small amount of lung-disease present. So I examined the sputum under the microscope, and found it full of bacilli looking like those of plague, and cultures were made from which a pure growth of the plague-bacillus was obtained. During 4th and 5th, patient became steadily worse, his temperature remained about 104, and his expectoration became most profuse; the moist sounds were heard over a larger area, as well as slightly at the bases, the respirations increased to 35, and then to 45, and the pulse to 120 and 135, and he ultimately died early on January 6th.

There is also the case of the nurse who attended him, who unfortunately died of a similar form of plague. In brief, she became ill on the evening of January 7th, and showed

symptoms of pneumonia on January 8th. She rapidly became worse and died on the 10th, but her sputum was not nearly so profuse as in the former case, and symptoms of exhaustion came on much earlier. She also had no glandular pain or enlargement whatever, and bacteriologically her sputum was exactly as described above. Other cases were met with, in which, besides plague-pneumonia, there was also general enlargement of the glands,—plague-septicæmia; and clinically it was found that either the pneumonia was primary, and the glandular enlargement secondary, or that the disease first shewed itself in the glands and later on in the lungs; and whilst some of the latter recovered, the former were usually rapidly fatal. Also the sputum was not always as has been described above, for in some cases the presence of blood in it was a marked feature, and it was either moderate or abundant in quantity. These pneumonic forms of plague are highly infectious, and probably take a large share in the spread of the disease; for in these cases the patient's sputum is practically a virulent pure culture of the plague-bacillus, and as there is reason to believe that many of the cases are not recognised as plague at all, precautions are not taken by the patients' friends, and the dangerous nature of the disease is not appreciated. I have no means of knowing how frequent this variety of plague has been in the present epidemic, but there is some evidence to show that a considerable number of cases have occurred. Moreover, it seems likely that a ship's passenger suffering from this form of plague might escape detection by sanitary officers, and might be permitted to land at his destination as though he were the subject of simple pneumonia; and so a centre of infection for the spread of plague would be established. With regard to the literature on this subject, I have not been able to find a published description of this variety of plague;* but an allusion to it is made in the accounts of the Pali epidemic of 1836, and it is stated that the Astrakhan outbreak of 1877 was first regarded as croupous pneumonia or as typhus complicated by pneumonia, from the reports on the Hongkong epidemic it appears that plague-pneumonia did not occur there. There is just this to add: the usual definition of plague in works on medicine is—"A specific fever attended by bubo of the inguinal or other glands," but it is clear that such a form of words does not include all varieties of the disease. (This paper was read before a meeting of the Bombay Medical and Physical Society on April 2nd, 1897.)

[Appendices B and C to Dr. Chittle's Report are omitted. They deal with involutions forms of the bacillus in the human body, and with a carbuncular case of plague.—J. K. C.]

SUMMARY OF WORK CARRIED ON BY MR. HANKIN.

Mr. Hankin has carried out a long series of researches on the action of disinfectants on the microbe of bubonic plague. He finds that it is somewhat resistant to the action of carbolic acid. Both phenyle, lysol, and izal appear to have a more energetic action. Phenyle and lysol, however, were found not to exert a marked bactericidal action on a cow-dung floor. Naphthalene was found to have no action on the plague-microbe. The plague-microbe was found to be comparatively resistant to the action of alkalies, and especially sensitive to the action of acids. Even weak organic acids appear to destroy it readily. It is, however, usually able to exist for some hours in acid urine. Milk, so soon as it has acquired an acid reaction, appears to have acquired the power of destroying the microbe. Inorganic acids are naturally still more active, and Mr. Hankin thinks that sulphuric acid might be used as a cheap disinfectant against the plague infection. The microbe was found to be resistant to the action of reducing agents, and sensitive to the action of oxidising agents, such as permanganate of potash or chloride of lime. A solution of one part of permanganate of potash in 50,000 parts of water appears to be capable of destroying

* *Vide* p 5, where an account by Dr. White is given.—J. K. C.

the plague-microbe in five minutes under the conditions of Mr. Hankin's experiments; but this substance is not recommended as a disinfectant except in cases in which there may be reason for thinking that water has been infected by the washing of infected clothes, etc. It was shown that the activity of potassium permanganate in destroying microbes may be greatly increased by the addition of a small quantity of sulphuric acid, but the mixture is not recommended except under special conditions. Mr. Hankin discusses the bearing of his observation of the sensitiveness of the microbe to oxidising agents on the generally advocated plan of combating the infection by means of ventilation, which, he shows, is probably a means of producing oxidation under the influence of air and light. A series of observations was made in houses undergoing disinfection. Results were obtained throwing doubt on the utility of sulphur fumigation and whitewashing as a means of destroying the microbe. Mr. Hankin comes to the conclusion that the only substance capable of satisfactorily disinfecting a cowdung floor is sublimate in an acid solution. Sublimate in a neutral solution was found to be without action on the microbes present. As an after-treatment and as a means of treating court-yards, passages, and drains, Mr. Hankin recommends sulphuric acid in a strength of 1 in 250, which solution he shows to be far cheaper than that of other disinfectants in common use. It is likely that this will make the treated places for some time unfitted to act as a nidus for the microbe, for the latter is shown to be destroyed within 5 minutes by a solution of the strength of 1 in 1429. Another method of disinfecting floors investigated by Mr. Hankin is by covering them with a layer of combustible material at least two inches thick, which is then set on fire. It was shown that this treatment is far more efficacious than the use of ordinary disinfectants. Though it is pointed out the risk of fire may prevent the wide application of the method in towns, it may find application in the treatment of public latrines that may be supposed to be infected, and which are commonly built of incombustible materials.

Mr. Hankin has also carried out a series of experiments on the asserted possibility of finding the bubonic microbe in the earth of infected houses. He has examined large numbers of specimens brought from places in which many people had recently succumbed to the infection without finding the microbe in any case, with one probable exception. The search has been carried out by several methods, including one communicated to him by Professor Calmette, which method appears to have been the one employed by Yersin in Hongkong, and which led him to positive results. In Mr. Hankin's hands no such results were obtained, thus throwing doubt on the statement that the microbe can be readily found in the soil of infected houses, at any rate by existing methods.

The only case in which a microbe probably identical with that of plague was met with was in some salt-water in a field near Siwri, at the time that the epidemic was present in the place. Some of this water was injected into a mouse. On its death a microbe was isolated from its organs, which resembled that of plague in most respects, but which differed from it in the rapidity with which it formed involution forms on agar-agar. Mr. Hankin found that the plague-microbe could be changed into a microbe having these aberrant characters by cultivation on agar-agar containing three or four per cent. of salt, and that further the microbe from Siwri was pathogenic to a rabbit that had not been protected by Haffkine's plague vaccine, but had no effect on a rabbit that had been so protected. Consequently it was supposed that this microbe was the plague-microbe altered by its sojourn in salt-water. This observation had led to the discovery of a rapid method of identifying the plague-microbe by its cultivation on agar-agar containing a certain percentage of salts. It has been further worked out by Surgeon-Captains James and Thomson under Mr. Hankin's supervision.

Mr Hankin has investigated the relation of insects to the dissemination of the disease. He has found the microbe in bugs from the Infectious Diseases Hospital. He has also found it in ants that had recently been eating rats dead of plague. A long series of experiments showed that ants do not retain the plague infection long, and further that no trace of infection is present in ants from localities in which rats have not been dying recently. Hence these insects cannot be regarded as important agents for the spread of the disease.

Experiments were carried out on different kinds of grain and other articles of export. They were infected with plague-microbes under many different conditions. At stated intervals extracts of specimens of the infected grain were prepared and injected into mice. By this means it was found that the infection usually died out within 4 to 6 days. The possibility was indicated that it might in exceptional cases survive for so long as 13 days, but of this no definite proof was obtained. Mr Hankin points out that grain, when it becomes rotten, usually acquires a well-marked acid reaction owing to the production of various fatty acids from the decomposition of carbohydrates. He has found that such fatty acids act as disinfectants for the bubonic microbe. Hence it is difficult to believe that the microbe can exist in rotten grain, as has been frequently assumed. The matter was put to an experimental test by Dr Srinivasa Rao while working in Mr Hankin's laboratory. It was found that the microbe always dies out in rotten grain within 2 to 24 hours.

The microbe, though usually dying out, when placed in sterilised water, within three days, appears to be able to survive in sterilised cowdung for several days. The observation appears to have some bearing on the question of the persistence of the infection in houses having cowdung and mud floors. Through lack of time these experiments could not be continued sufficiently for any conclusion to be arrived at as to whether any particular kind of filth is more suitable than another to sustain the life of the microbe. *But the general trend of Mr Hankin's observations is to indicate that the chief source of infection is not likely to be in a saprophytic form of the microbe in the outside world, but more probably in the recently passed excreta of men or animals suffering from the disease.*

[Special emphasis has been laid on the last sentence of Dr Childe's Report, in order to draw attention to a conjecture which, though founded on slender evidence, appears nevertheless to belong to that order of conjectures which ultimately prove of the highest importance.—J. K. C.]

PLATE I.

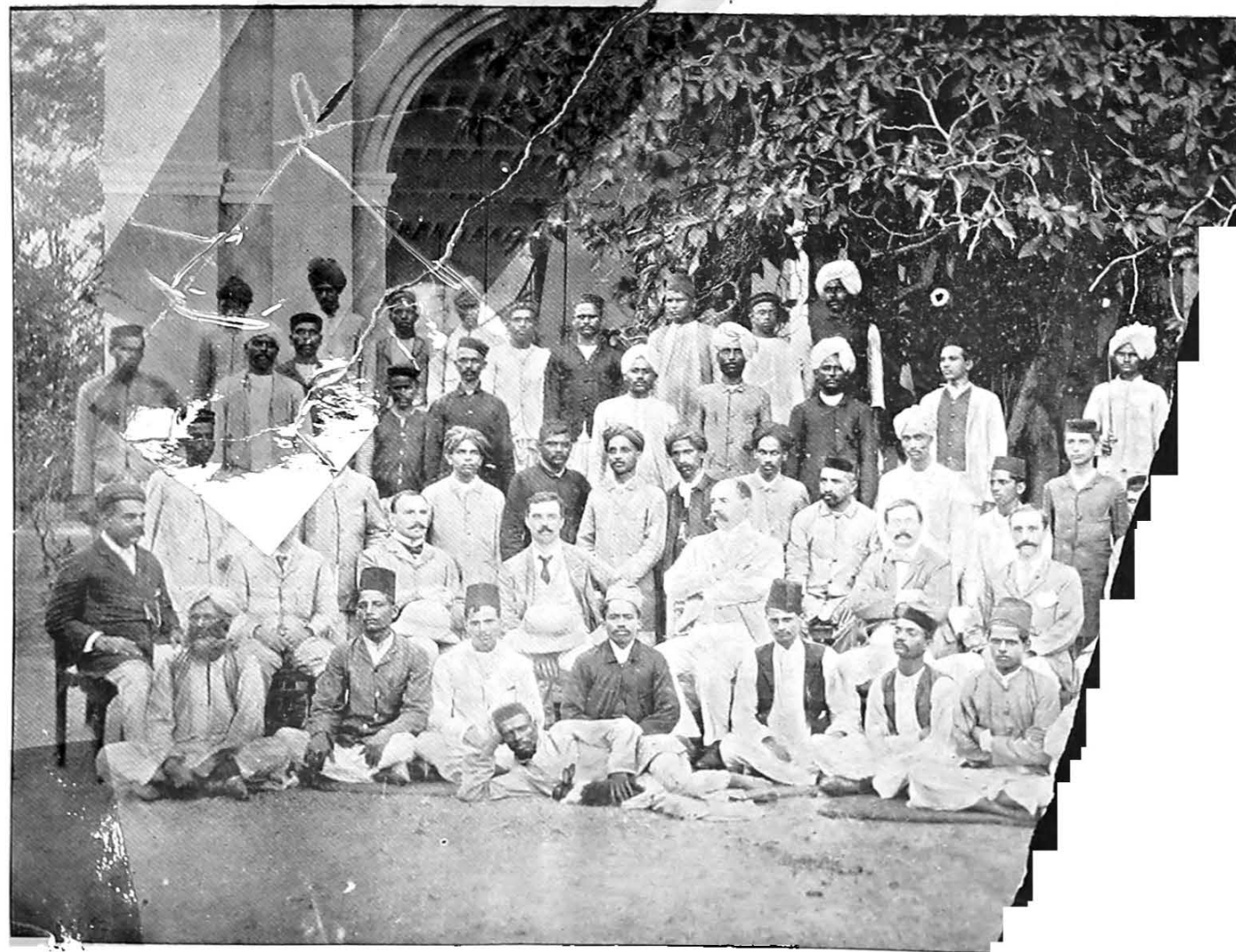


Plate 1.

THE STAFF OF THE IMPERIAL RESEARCH LABORATORY.