THE ETIOLOGY AND EPIDEMIOLOGY OF PLAGUE

A SUMMARY OF THE WORK
OF
THE PLAGUE COMMISSION.

ISSUED UNDER THE AUTHORITY OF THE
GOVERNMENT OF INDIA BY THE SANITARY COMMISSIONER
WITH THE GOVERNMENT OF INDIA, SIMLA.

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PREFACE.

IN the early days of plague in India most strenuous efforts were made to stamp it out by the means adopted in European countries in dealing with epidemic disease, but these efforts failed and they too often led directly to the misfortunes which they were designed to avert. When it was recognized that it was impossible to deal effectively with the epidemic without the help of the people themselves, a policy of persuasion and assistance was substituted for the more rigorous measures, but this also failed to prevent the extension of the disease, although in many places some degree of success was achieved.

Considerable progress had been made in the study of the epidemiology of plague and valuable work had been done in laboratories in India and elsewhere, but there remained serious gaps in our knowledge which it was necessary to fill in order to give greater precision to the measures of prevention which it was possible to adopt. In the autumn of 1904 the Government of India therefore addressed the Right Hon'ble the Secretary of State for India with a view to undertaking a more complete enquiry into the etiology of the disease than had hitherto been attempted. As a result of this representation the Secretary of State replied that, on the recommendation of the Royal Society and the Lister Institute, he proposed to form a committee representing these bodies and the India Office and to grant to them £5,000 renewable annually for the purposes of the investigation, which

it was proposed should be undertaken under the direction of the committee by two experts chosen and paid by them and two skilled bacteriologists belonging to the Indian Medical Service. These proposals were accepted by the Government of India, and an Advisory Committee was appointed consisting of the following members :—

Surgeon-General Branfoot, C.I.E., I.M.S.,	India Office; *President.*
Sir Michael Foster, K.C.B., F.R.S.	Royal Society
Professor J. Rose Bradford, M.D., F.R.S. ..	
Colonel David Bruce, C.B., R.A.M.C., F.R.S.	Lister Institute.
Dr. C. J. Martin, F.R.S. ..	

(On the death of Sir Michael Foster in January 1907 his place on the Committee was filled by the appointment of Dr. G. H. Nuttall, F.R.S.)

The Committee decided that Dr. Martin should visit India to confer with the authorities there regarding procedure and to initiate the work.

Dr. Martin arrived in Bombay early in April 1905, and was followed in May by Drs. Petrie and Rowland, the experts chosen by the Committee. After visiting Kasauli Dr. Martin decided to commence work at Parel, near Bombay, where the Plague Research Laboratory offered special facilities.

In May the Government of India placed Captain Liston's services at the disposal of the Committee. Dr. Martin, having resolved to remain in Bombay during the summer, dispensed with the services of the second officer of the Indian Medical Service during his stay. Shortly before his departure on the 14th October 1905, the services of Major Lamb were placed at the disposal

of the Committee. Before his departure Dr. Martin represented the desirability of further assistance being given, and Captain Gloster, I.M.S., was deputed to work in the Punjab under the orders of the Committee. When Dr. Martin left India he handed over the direction of the working Commission to Major Lamb as Senior Member, when the Commission consisted of the following members :—

Major George Lamb, M.D., I.M.S., Director of the Pasteur Institute of India, Kasauli ; *Senior Member.*

Captain William Glen Liston, M.D., I.M.S., Plague Research Laboratory, Parel.

Captain Thomas Henry Gloster, M.B., B.Ch., I.M.S.

George Ford Petrie, M.D., Assistant Bacteriologist, Lister Institute.

Sydney Rowland, M.A., M.R.C.S., L.R.C.P., Assistant Bacteriologist, Lister Institute.

M. Kesava Pai, M.B., C.M., Assistant Surgeon, Assistant to the Director, Pasteur Institute, Coonoor ; lent by the Government of Madras.

V. L. Manker, L.R.C.P., L.R.C.S., D.P.H.

P. S. Ramchandrier, Hospital Assistant, Mysore ; lent by the Government of Mysore.

C. R. Avari, Hospital Assistant, Plague Research Laboratory ; lent by the Government of Bombay

The Commission thus constituted continued to work until May 1907, when it was considered that satisfactory replies to the questions which had been placed before them had been found, and the Commission was temporarily dissolved.

The head-quarters of the Commission remained at the Plague Research Laboratory, Parel, the Director of which, Lieutenant-Colonel Bannerman, I.M.S., placed every resource of his laboratory freely at their disposal.

It was arranged that reports of the work done by the Commission should be published by the Advisory Committee in the *Journal of Hygiene*, of which two numbers containing reports have already been published. It seemed to the Government of India, however, necessary that an account of the work done by the Commission should be submitted in a simple form to the public as soon as possible, and the following summary has been compiled for that purpose. It is intended that the facts ascertained shall be used by administrators in framing measures for the prevention of plague, and it is hoped that the knowledge of the facts will help the people to understand the reasons for those measures.

The summary has been compiled by Major George Lamb, I.M.S., who is alone responsible for the form in which the observations are set forth and for the way in which they are interpreted.

J. T. W. L.

SIMLA,
The 27th October 1907.

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CONTENTS.

CONTENTS.

THE

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PART I.—INTRODUCTION.

The first duty of the Commission was by study of the literature and by careful enquiry from workers in India to ascertain the main conclusions which had been already formed regarding the epidemiology of plague. In the first progress report to the Advisory Committee these conclusions were set forth and may be briefly summarised as follows:—

(1) Plague, with the exception of the pneumonic form, which, however, is uncommon (2·5 per cent. of all cases), is not particularly infectious or contagious and man to man infection plays no important part in the spread of epidemics in India. The disease may, however, be introduced into a new locality and so ultimately occasion a new outbreak by the agency of man. For this to occur it is not necessary that the human agent himself should be suffering from the disease.

(2) Definite localities, huts, rooms or houses, in which plague has occurred amongst rats or man, are during an epidemic highly infectious. Further, the infection seems to cling to these localities for a long time.

(3) While plague can exist and spread under a great range of climatic conditions, it exhibits a marked seasonal prevalence, which is the most striking feature of the epidemiology of the disease.

(4) In the great majority of instances plague in man is associated with an epizootic among rats: and there seemed to be the strongest reasons for regarding the epizootic amongst rats as by far the most important cause of the epidemic spread of the disease.

It is necessary to state that, although the work of the present Commission has demonstrated the part played by the

rat and the rat-flea in the spread of plague, this demonstration did not surprise plague workers in India. On the contrary, the observations, both epidemiological and experimental, which had been made in India pointed to this conclusion. Lieutenant-Colonel W. B. Bannerman, I.M.S., has put on record the state of knowledge as regards the spread of plague prior to the commencement of work by the Commission in a paper published in the *Journal of Hygiene* of April 1906. This paper is a digest of "many very valuable reports made by officers of the Indian Medical Service who have dealt personally with plague epidemics, which reports existing in the archives of the various local Governments are not available for reference by the public." Colonel Bannerman shows that the trend of opinion amongst workers in India was, that plague is disseminated through rats and that its spread to man is occasioned by the agency of fleas. In this connection Captain W. Glen Liston, I.M.S. (*Indian Medical Gazette*, February 1905) had shown that the common rat-flea in India was *Pulex cheopis* and that this flea would bite man. In fact he had taken many specimens of this flea on human beings in a plague-infected house. He had also used guineapigs as traps for *P. cheopis* in plague-infected houses and had on several occasions observed that these animals became infected with plague when exposed in this way. He had made the further observation that numerous plague bacilli were to be found in the stomach contents of rat-fleas taken on guineapigs in plague-infected houses. Finally, so convinced were Colonel Bannerman and Captain Liston of the truth of the flea transmission theory that they had designed and built at the Plague Research Laboratory, Parel, special godowns or cabins, in which it was proposed to carry out large series of experiments to prove this theory. These godowns had just been completed when the Plague Commission began work and, as we shall see, the experiments which were made in them by the Commission went far to prove that the rat-flea is the only agent of transmission of plague infection from animal to animal.

It is not then too much to say that the work of the Commission has been a cope-stone to careful and tedious investigations already carried out in India—and of course elsewhere—rather than an original building, and that to the preliminary work and to the ready and whole-hearted assistance which the Commis-

sion received in India from all concerned the success of their labours is largely due.

The work of the Commission consisted of both epidemiological observations and experimental investigations. The epidemiological observations were made in the City of Bombay itself, in four villages in the north of the Island of Bombay within easy distance of the Parel Laboratory and in two isolated villages in the Amritsar district of the Punjab. The experimental work was carried out at the head-quarters of the Commission, namely, the Plague Research Laboratory, Parel, Bombay.

PART IX.—GENERAL CONCLUSIONS.

1. Pneumonic plague is highly contagious. It is, however, rare (less than 3 per cent. of all cases) and plays a very small part in the general spread of the disease.
2. Bubonic plague in man is entirely dependent on the disease in the rat.
3. The infection is conveyed from rat to rat and from rat to man solely by means of the rat-flea.
4. A case of bubonic plague in man is not in itself infectious.
5. A large majority of plague cases occur singly in houses. When more than one case occurs in a house, the attacks are generally nearly simultaneous.
6. Plague is usually conveyed from place to place by imported rat-fleas, which are carried by people on their persons or in their baggage. The human agent not infrequently himself escapes infection.
7. Insanitary conditions have no relation to the occurrence of plague, except in so far as they favour infestation by rats.
8. The non-epidemic season is bridged over by acute plague in the rat, accompanied by a few cases amongst human beings.

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