Report of the International Plague Conference

HELD AT

MUKDEN, APRIL, 1911

MANILA
BUREAU OF PRINTING
1912

PREFACE

The epidemic of pneumonic plague, which raged in Manchuria and north China during the winter months of 1910–11, caused the death of nearly 50,000 people. No outbreak of this magnitude and nature has occurred in modern times, and hitherto, as our knowledge concerning epidemic pneumonic plague has been meager, the study of the Manchurian epidemic, in all of its features, was one of particular importance.

When the outbreak assumed alarming proportions, the Chinese Government, actuated by the highest motives of humanity, invited the eleven foreign powers represented at Peking to send specialists to attend an international plague conference for the purpose of throwing further light upon the nature of the disease and to give advice regarding methods for its prevention. This Conference was held in Mukden, one of the larger cities which suffered severely from the disease, where the Delegates were officially received by His Excellency Hsi Liang, viceroy, and the Hon. Sao Ke Alfred Sze, Imperial Commissioner. The proceedings of this Conference and the information gained therefrom, together with the results of certain supplementary bacteriological investigations, constitute the present Report.

The Conference considered almost exclusively the subject of the pneumonic form of plague and endeavored to investigate the question of bubonic plague only in so far as it seemed to bear some relation to or to throw light upon the Manchurian epidemic.

The publication of the Report was placed in the hands of an editorial committee consisting of Dr. Martini, Dr. Petrie, Dr. Stanley, and the writer. Dr. Martini has reread the evidence in Part I of the bacteriological section and Drs. Petrie and Stanley the evidence in Part I of the epidemiological section. In addition, Dr. Petrie has prepared the epidemiological review in Part III and Dr. Stanley the summary in Part III, regarding the measures employed to combat the epidemic. The writer has reread the entire Report and prepared the same for publication, and also is responsible for the summary in Part III upon the clinical, bacteriological, and pathological features of the disease. I have to thank Miss H. E. Kupfer of the Bureau of Science and Mr. S. H. Musick of the Bureau of Printing for much valuable assistance in preparing the Report for the press.

It was necessary to redraw all of the charts which are reproduced in the Report. This work was performed at the Bureau of Science, Manila.

Owing to the fact that the same subject was often discussed in several different sessions of the Conference and that epidemiological questions were sometimes considered in the bacteriological sessions, at first, the reader may fear, upon turning through the pages of the Report, that it will be difficult to obtain all of the evidence upon some particular subject. However, if the Table of Contents together with the Index are consulted carefully, it is believed that this difficulty will be obviated. In any case, no better arrangement of the material could be made, for the Chinese Government desired the original form of the report of the Conference to be retained so far as possible. For the reason that the programme arranged for the daily sessions of the Conference was not always fully carried out, a summary of the proceedings of each session also has been added to the Table of Contents and to the chapter headings.

The publication has been divided into three parts: Part I, in addition to the proceedings in relation to the opening of the Conference and the arrangement of the programme and of the Rules of Procedure, is occupied almost entirely with the evidence presented regarding the epidemic and the discussion regarding the same. Part II consists of two sections: The first comprises the discussions which took place relating to the preparation of the provisional conclusions and resolutions forming the Interim Report. In this section the reader probably will find little of scientific interest; however, it was the wish of the Chinese Government that the complete record of the Conference should be published. The second section of Part II consists of the Interim Report to the Chinese Government and of that of the closing ceremony of the Conference. Part III consists of a summary of our knowledge gained from the study of the epidemic. In regard to the record of the proceedings (in Parts I and II), it may be stated that, because so many nationalities were represented in the personnel of the Conference and for this reason there was the necessity for the majority of those presenting evidence to speak in a foreign tongue (the official languages actually *employed* were English, German, and French), the task of conveying in the record the exact idea of the speaker sometimes was not an easy one. However, the proceedings were reread by the Editorial Committee and the Medical Secretary as soon as the record of each session had been typewritten, and authors were consulted regarding any testimony in which there appeared

to be a discrepancy between the remarks made by the individual and the stenographic record of the same. In addition, minutes of the proceedings of each session were submitted to the Conference at the beginning of the following session for acceptance, for revision, or for correction. It was largely due to the efforts of Dr. Aspland, the medical secretary, Mr. Lauru, the secretary, and Mr. Woodhead, the official stenographer, aided by their assistants, that the proceedings of the Conference were so completely recorded. Fortunately in a number of instances the original manuscripts written in German also were presented, and these have been carefully consulted in editing the Report. Certain discrepancies will be found in different portions of the Report regarding the dates of infection in certain towns and the number of people infected. It was not always found possible to harmonize these, as the dates and statistics given in the official records sometimes were found to vary. The reader may not always be reconciled to the spelling adopted in the Report for Chinese and Manchurian geographical names. The writer is not aware of any definitive authority on this subject, but has striven to obtain uniformity.

In editing the Report for publication, it was found that in several instances the evidence upon certain subjects discussed in the bacteriological sessions was not entirely complete, and it was necessary to perform further experiments to complete the evidence; also, upon the subject of the susceptibility to infection with pneumonic plague of donkeys and dogs, and the question of the efficacy of vaccination against pneumonic plague, the Conference recommended that further experimental work be performed. Experiments on these subjects have been carried out by Dr. Teague and the writer, and the results briefly referred to, either in footnotes in Part I or in the text in Part III, Chapter III, of the bacteriological section of the Report.

RICHARD P. STRONG.

MANILA, P. I., *October, 1911.*

LIST OF DELEGATES TO THE INTERNATIONAL PLAGUE CONFERENCE

AMERICA, UNITED STATES OF

Dr. R. P. Strong, Ph. B., M. D.; professor of Tropical Medicine, chief of Biological Laboratory, Bureau of Science, Manila.

Dr. Oscar Teague, M. S., M. D.; assistant, Biological Laboratory, Bureau of Science, Manila.

AUSTRIA-HUNGARY

Dr. Eugen Worell, surgeon, Imperial and Royal Austro-Hungarian Navy.

FRANCE

Dr. C. Broquet, surgeon, French Army; formerly assistant director of the Pasteur Institute in Indo-China (captain).

GERMANY

Professor Dr. Erich Martini, surgeon-general, Imperial German Navy (attached to the Ministry of Interior).

GREAT BRITAIN

Dr. Reginald Farrar, M. D., D. P. H.; Local Government Board inspector, London.

Dr. G. F. Petrie, M. D.; Lister Institute of Preventive Medicine; member of Plague Research Commission, India 1905 to 1907; bacteriologist in charge, Investigation of Rat Infection in East-Anglia.

Dr. G. Douglas Gray, M. D.; physician to H. B. M.'s Legation, Peking.

ITALY

Dr. Gino Galeotti, professor of Experimental Pathology, Royal University of Naples, Italy.

Dr. di Giura, surgeon, Italian Navy; physician to the Italian Legation, Peking.

Dr. Ernesto Signorelli, assistant, Laboratory of Experimental Pathology, Royal University of Naples, Italy.

JAPAN

Professor Dr. S. Kitasato, director of the Imperial Institute for Infectious Diseases, Tokyo; F. R. S. London. (Royal professor, Prussia.)

Dr. Akira Fujinami, professor of Pathological Anatomy, Imperial University of Kyoto.

Professor Dr. G. Shibayama, chief of Clinical Department, Imperial Institute for Infectious Diseases, Tokyo.

Dr. M. Uyama, staff surgeon-general, Japanese Army.

Dr. K. Shimose, surgeon, Japanese Army; physician to H. I. J. M.'s Legation, Peking (lieutenant-colonel).

MEXICO

Dr. O. Gonzalez-Fabela, professor of Bacteriology, National School of Medicine; bacteriologist of the Pathological Institute and of the Superior Board of Health, Mexico.

NETHERLANDS

Dr. F. H. Hehewerth, surgeon, Netherlands Indian Army (captain).

RUSSIA

Professor D. Zabolotny, professor of Bacteriology, Medical Institute, St. Petersburg; chief of Syphilogical Laboratory, Imperial Institute of Experimental Medicine, St. Petersburg; chief of Russian Commission for Plague Investigation in China.

Dr. S. T. Zlatogoroff, assistant chief of Bacteriological Laboratory, Medical Institute, St. Petersburg, member of Russian Commission for Plague Investigation in China.

Professor Dr. G. Koulecha, prosector Municipal Hospital of Ste. Marie-Madeleine, St. Petersburg; member of the Russian Commission for Plague Investigation in China.

Dr. L. Padlevsky, assistant, Institute of Pathology; assistant director, Institute of Bacteriology, Imperial University of Moscow; member of Russian Commission for Plague Investigation in China.

Dr. Marie Ssouragewskaja, assistant, Institute Sero-diagnostic, St. Petersburg; assistant member of Russian Commission for Plague Investigation in China.

Dr. Anna Tchourilina, assistant, Bacteriologic and Hygienic Laboratory, High Medical School for Women, St. Petersburg; assistant member of Russian Commission for Plague Investigation in China.

CHINA

Dr. Wu Lien Teh, B. C., M. A., M. D. (Cambridge); assistant director of Imperial Army Medical College, Tientsin.

Dr. Ch'uan Shao Ching, official of the Fourth Civil Rank, designated assistant sub-prefect; professor of Medicine, Therapeutics, and Medical Jurisprudence, Imperial Medical College, and medical officer, Pei-Yang Hospital, Tientsin.

Dr. Fang Chin, M. D. (Chiba); professor of Bacteriology, Imperial Army Medical College, Tientsin.

Dr. Y. S. Wang, doctor in charge of Sanitary Hospital; assistant director, Antiplague Bureau, Mukden; expectant district magistrate.

Dr. R. A. P. Hill, M. B. (Cambridge), D. P. H. (London); lecturer in the Union Medical College, Peking.

Dr. W. H. Graham Aspland, M. D., F. R. C. S.; professor in the Union Medical College, and Peking University; medical superintendent of Anglican Hospital, Peking.

Dr. Dugald Christie, F. R. C. P., F. R. C. S. (Ed.); director of the Mukden Hospital and medical adviser to the Manchurian Government.

Dr. Arthur Stanley, M. D., B. S. (London), D. P. H.; health officer of the Shanghai Municipal Council.

Dr. Paul B. Haffkine, director of the Russian Plague Hospital, Harbin.

DEPUTIES

RUSSIA

Monsieur M. KOKCHAROFF, president of the Russian Antiplague Bureau, Harbin.
Dr. PAUL WOSCRESSENSKY, surgeon, Chinese Eastern Railway.
Dr. F. IASIENSKI, chief of the Medical Staff, Chinese Eastern Railway.
Dr. WINCENTY BOGUCKI, medical superintendent of the Russian Antiplague Bureau, Harbin.

CHINA

Dr. WOO WAI U, surgeon, Imperial Guard; deputy from the Ministry of Interior, Peking.
Dr. J. CHABANEIX, surgeon, French Army; professor at the Imperial School of Medicine, Tientsin; attached to the Sanitary Department of the Province of Chihli (major).
Dr. C. W. WONG, assistant professor, Imperial Army Medical College, Tientsin; deputy from Fengtien Province.
Mr. L. S. WANG, pharmaceutical adviser to the Government of Fengtien Province; deputy from Fengtien Province.
Dr. M. S. CHUNG, taotai designated; director of the Government Hospital, Kirin; deputy from Kirin Province.
Dr. WANG HSING-AN, deputy from Heilungkiang Province.
Dr. B. Y. WONG, deputy of the Imperial Chinese Red Cross Society and the Chinese Public Isolation Hospital, Shanghai.
Dr. P. QUINCEY, resident physician, Shanghai Hospital.

SECRETARIES

Dr. W. H. GRAHAM ASPLAND (as above), medical secretary.
Mr. C. H. LAURU, deputy commissioner, Imperial Maritime Customs, secretary.
Mr. SZE SHAO-TSANG, official with brevet of the Third Civil Rank, member of the WAIWUPU, Chinese secretary.
Mr. TSANG WOO HUAN, official with brevet of the Second Civil Rank, member of the WAIWUPU, secretary interpreter.
Mr. H. G. W. WOODHEAD, M. J. I., official stenographer.
Mr. LI KWAY YOONG, Chinese Imperial Customs, clerk.
Mr. LI WEN HOEI, Chinese Imperial Posts, clerk.

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OPENING CEREMONY, APRIL 3

PROGRAMME

1. Reception of Delegates and guests by His Excellency Hsi Liang, viceroy, and the Hon. Sao Ke Alfred Sze, Imperial commissioner.
2. Opening of the Conference.
   a. Message from His Imperial Highness the Prince Regent.
   b. Address of welcome by His Excellency the Viceroy.
   c. Address by the Imperial Commissioner, the Hon. Sao Ke Alfred Sze.
   d. Reply by the representative of the foreign Delegates.

The opening ceremony took place at 10 a. m. on Monday, April 3, 1911, in the Conference Building at Mukden, where Delegates, deputies, and guests, including members of the various diplomatic corps, were received in the Conference Hall by His Excellency Hsi Liang, viceroy of the Three Eastern Provinces, and the Imperial Commissioner, the Hon. Sao Ke Alfred Sze.

The Conference came to order shortly after 10 a. m., the Hon. Sao Ke Alfred Sze presiding.

His Excellency the Viceroy then read the message from His Imperial Highness the Prince Regent, which was translated into English by Mr. Tsang Woo Huan as follows:

"The WAIWUPU respectfully transmits the following message from His Imperial Highness the PRINCE REGENT, dated Peking, April 2:

" 'WE ARE NOW ON THE EVE OF THE OPENING OF THE INTERNATIONAL PLAGUE CONFERENCE IN MUKDEN, AND WE ARE DELIGHTED THAT THE DIFFERENT GOVERNMENTS HAVE DEPUTED SPECIALISTS TO ATTEND AND TO ASSIST IN THE DELIBERATIONS OF THE CONFERENCE. WE HAVE FOLLOWED THE COURSE OF THIS EPIDEMIC WITH GREAT ATTENTION, AND THIS CONFERENCE, IN WHICH DIFFERENT EXPERTS WILL PARTICIPATE, WILL, WE FEEL SURE, THROW MUCH LIGHT UPON THE DISEASE, NOT ONLY FROM THE PURELY SCIENTIFIC STANDPOINT, BUT ALSO FROM THE POINT OF VIEW OF METHODS OF PREVENTION AND TREATMENT, WHICH WILL MINIMIZE SUFFERING FROM PLAGUE IN THE FUTURE. WE SINCERELY TRUST THAT THE FRUIT OF YOUR LABORS WILL ADVANCE THE CAUSE OF HUMANITY, AND BRING INFINITE BLESSING TO MANKIND.' "

His Excellency the Viceroy, Hsi Liang, then delivered the address of welcome to the Delegates of the Conference, the English translation of which, read by Mr. Tsang Woo Huan, is as follows:

ADDRESS OF WELCOME

By H. E. HSI LIANG

"Honorable Delegates, Ladies, and Gentlemen, it is with great pleasure that I welcome you to this ancient capital of Mukden. His Majesty the Emperor, prompted by the highest motives of humanity, has invited all the friendly Powers to join this Conference, and I appreciate deeply the sense of duty to, and love for, mankind which has prompted your several Governments to send you so far away from your lands to attend this International Plague Conference. The Chinese Government and people all over this Empire will not easily forget the eager response you have shown to the cause of humanity by accepting our invitation to be present, and I sincerely hope that your deliberations during the next few weeks will result in the saving of human lives, not only of this country but of others also, should this terrible disease unfortunately break out elsewhere. We, Chinese, have for a long time believed in an ancient system of medical practice, which the experience of centuries has found to be serviceable for many ailments, but the lessons taught by this epidemic, which until practically three or four months ago had been unknown in China, have been great, and have compelled several of us to revise our former ideas of this valuable branch of knowledge. We feel that the progress of medical science must go hand in hand with the advancement of learning, and that if railways, telegraphs, electric light, and other modern inventions are indispensable to the material welfare of this country, we should also make use of the wonderful resources of Western medicine for the benefit of our people. I am told that even in Europe the views in regard to medical science have changed considerably for the better since the late King Edward VII of England gave his remarkable address at the International Sanitary Congress held in 1894. In the course of his speech, whilst dealing with infectious diseases, he said: 'If preventable, why not prevented?' We in China, too, are appreciating the value of that dictum. I trust and I believe, too, that modern medicine, and especially sanitary science, will in future receive more attention in this country than it has hitherto done, and that we shall be better prepared to deal with similar epidemics when they arise. My great regret is that as many as forty thousand lives have been lost in these provinces, especially including those of some

of our foreign doctors, whose unselfish devotion to duty and the welfare of our people I shall always remember.

"Ladies and Gentlemen of this Conference, you who are so well known in your countries and in the medical world, and have come to Mukden at great sacrifice, I extend to you a hearty welcome to this ancient city. This is the first time we have held a conference of this kind, and we trust you will overlook any little details missed regarding your comfort whilst staying in this city."

The Hon. Sao Ke Alfred Sze, Imperial Chinese Commissioner deputed by the Throne to attend the Conference on its behalf, then read in English the following address:

ADDRESS OF THE IMPERIAL COMMISSIONER

Hon. Sao Ke Alfred Sze

"Gentlemen, I am deputed by the officials of the Central Government to extend to you their hearty welcome, and through you their thanks to your respective Governments, for the trouble you have taken in coming to this Conference.

"During the past five months north China, and especially Manchuria, has been ravaged by one of the most fatal epidemics, in point of view of infectiousness and high mortality, that has occurred in living memory. Smallpox, cholera, bubonic plague, and similar diseases have no doubt a high mortality rate, but pneumonic and septicæmic plague are worse than all these. I believe I am correct in putting the death rate at almost, if not exactly, 100 per cent.

"The conditions which have produced this epidemic are not such as can be easily altered without interfering with trade, with the daily bread of many thousands of men, and with the national habits and customs of our people. If we are to believe the able scientists who have already studied the subject, there is present in northwest Manchuria as well as over the greater part of the mountains of Asia a marmot (the tarbagan), a small rodent animal that suffers more or less permanently from swellings, in which plague bacilli are found. This animal is hunted for its fur, and it was among the thousands of trappers who meet annually in northwest Manchuria to capture it, that the first outbreak occurred.

"The conditions of climate are of the worst kind. The winter temperature falls to 40° F. below zero, and it has been described as one of the coldest places in the civilized world. In such bitter cold no man remains out of doors a minute longer than he can help. The earning capacity of the people is then at its lowest,

and it is not a wonder they keep huddled together in their small houses in a way that is most favorable to the spread of such a highly infectious disease as pneumonic plague.

"I am sorry to say you will have no difficulty in finding that the sanitary conditions of many of the towns and villages are defective, but I believe they are no worse than those of all large countries in the Near and Far East. As the British Government knows, from its experience in India, effective sanitation is a very difficult problem indeed in such a vast country as ours, with so many millions of people to deal with. We will welcome any practical suggestions you may be able to make on this subject, which is one that we recognize as capable of amelioration.

"One fact in this epidemic which stands out before all others is that it has spread mainly from town to town *along the railway lines of communication.* As in many other instances, we were taken unawares. It was known that an epidemic had occurred in Mongolia and even at Newchwang, without spreading any great distance. It was not, however, recognized that this epidemic would be one of such unheard-of virulence, and, when this was realized, the epidemic had already begun to spread southward.

"Our national festival takes place at the time of New Year, and every Chinese who can do it makes strenuous endeavors to return to his home. Many thousands of returning coolies, if not taken by rail, become foot passengers and walk across country. No cordon has as yet been found effective, even by the employment of large numbers of troops, that could prevent people slipping through in such a vast tract of country.

"Quarantine measures were enforced on the railway, but probably not soon enough. The experience we have gained this time makes us hope to adopt measures that will admit of ready enforcement in the future. No doubt some of you gentlemen from your previous experience will be able to help us with useful advice as to what methods are best for quarantining large bodies of the irresponsible coolie class.

"You will receive accounts from the different doctors employed on antiplague duty as to how they have dealt with the segregation of contacts and suspects and how they have managed the isolation hospitals for plague-stricken cases; and we will welcome your helpful criticisms on this subject, for we feel that the time has come for us to adopt such measures as will prevent repetitions of the disasters we have witnessed when frequently whole households have been wiped out within the course of a few days.

"While the Chinese people have not such caste prejudices as

are present in some other oriental races, they are apt to resent what they consider undue interference with, or intrusion into, their family life; and it has been a difficult official duty for us to carry out such apparently cruel work—the quick separation of a plague case from his or her family relatives, removal of one member to the plague hospital and others to segregation camps, and so on.

"While not wishing to lay out in too much detail the work we invite you to consider, and while at the same time recognizing that the medical and scientific aspects of the question will receive your full share of attention, I would venture to ask you to discuss more especially the following points:

"1. The origin and mode of spread of the epidemic and the management of it.

"2. Is it connected with an endemic focus in Manchuria. And if so, what are the best measures to combat that focus.

"3. Has the pneumonic plague bacillus greater toxic power than the bacillus that causes bubonic plague. In other words, why should a bacillus, which, so far as we know, has the same microscopic appearances and answers to the same bacteriological tests, cause a pneumonic and septicæmic epidemic here and only give rise to bubonic plague in India and other places, where pneumonic cases only incidentally occur.

"4. How is it that, according to all medical evidence we possess, the epidemic has been purely a human one with no evidence of rat infection.

"5. On what circumstances does the difference between pneumonic and bubonic plague depend.

"6. Is aërial infection possible, or does infection depend solely on chance contagion.

"7. Is this bacillus able to exist for months outside the human body. And if so, under what conditions. This is for us an important question, as it may mean a possible outbreak next winter.

"8. What methods should we follow in order to prevent, if possible, a recurrence.

"9. To what extent may trade be carried on under such unusual epidemic circumstances—e. g., the valuable bean trade and the enormous export of skins and furs.

"10. Do you advise the institution of wholesale inoculation, on a systematic plan, of towns and villages.

"11. Are such active measures as the burning of plague-stricken houses advisable or, from your experience, can a system of disinfection of premises suffice.

"12. How far are vaccines and serums reliable as means of protection and cure in such cases.

"Gentlemen, in asking your consideration of these questions and any other suggestions which you may, from your past experience, see fit to make, I will, on behalf of my Emperor and Government, respectfully beg of you to have ever the practical side of the subject in view. Science comes often into conflict with daily life, just as it is ever aiding it. What may be scientifically and theoretically desirable may, when the time comes for it to be put into actual practice, be found impossible to carry out; but we are determined to meet this enemy henceforth armed with the best knowledge we can obtain. We will thoroughly consider your recommendations, and whenever possible act up to them. The day has now gone past when any government can allow an epidemic to cause such ravages among its people unchecked, not only for economic but also for humanitarian reasons.

"Before closing, may I introduce to you Dr. Wu Lien Teh, who will act as chairman of your meetings? Dr. Wu has for the past three months been living in the worst plague-stricken area, studying the disease in every aspect. He has had a distinguished career in England, and has worked in French and German laboratories. We have instructed him to see that the words of every member of this Conference are received with careful attention. We have also appointed Dr. Graham Aspland to act as medical secretary to the Conference. Dr. Aspland was at Fuchiatien during the worst time of the epidemic, and has rendered valuable services to us.

"Finally I may add that facilities for railway travel will be given to the members whenever necessary, and I trust the arrangements made by my Government for your residence will be found comfortable by you during your stay here."

Professor D. Zabolotny then replied for the Delegates as follows:

REPLY BY THE REPRESENTATIVE OF THE FOREIGN DELEGATES

By Professor D. ZABOLOTNY

"Your Excellency, I am asked by my fellow-Delegates to convey to you their deep appreciation of your kindly words of welcome.

"We represent ten [1] foreign nations, powers of the civilized world, who have responded to the invitation of the Imperial Chinese Government to help her in elucidating this problem of

[1] The Delegate from the eleventh nation (Mexico) represented at the Conference arrived a few days later.—[EDITOR.]

plague, the world-wide scourge of mankind. In sending us here, our respective Governments extend to China their sympathy, while earnestly hoping that we, by our deliberations, may help in the adoption of measures which may prove efficient in preventing a recrudescence of this virulent malady.

"Those of us who are epidemiologists and those of us who devote the main part of our life work to the science of bacteriology, meet upon a common ground of previous inexperience of such a widespread epidemic of pneumonic and septicæmic plague. In living memory a similar occurrence has not happened, but the facts observed during the past six months give us good ground for believing that the well-established rules for the prevention of infection are capable of being adopted in future in such a way as to aid you in fighting another epidemic, an eventuality which, however much we may wish will not occur again, must nevertheless be regarded as a possibility.

"We congratulate the Imperial Government on the enlightened path it has followed in coping with the situation. Your Excellency and your able officers are also to be congratulated on the whole-hearted way you have worked in the cause of your plague-stricken people.

"The courage and ability shown by the doctors and their plague staffs, Chinese and foreign alike, has commanded universal admiration, and we trust that the benefits of scientific medical work, as shown in this epidemic, will elevate our profession in your Empire and make it a calling worthy of being followed by the best of your young men.

"We thank Your Excellency most heartily for all the many arrangements you have made for our comfort. We are thus enabled to carry out the work under the happiest circumstances, which will contribute not a little to the harmony of our proceedings.

"Not only have we appreciated Your Excellency's sentiments, but we are also impressed by the address from your august Emperor and his Central Government so ably delivered by Mr. Commissioner Sze, to whom in passing we would take this opportunity of expressing our indebtedness.

"We have listened with great gratification to the kindly message of welcome sent to us by His Imperial Highness the Prince Regent. In the name of my fellow-Delegates, I beg Your Excellency to convey our respectful duty to His Imperial Majesty the Emperor of China, and our thanks for the welcome so graciously extended to us."

After the translation of these remarks into Chinese had been read, the meeting adjourned until 2.30 p. m.

MINUTES OF A SPECIAL MEETING OF DELEGATES, APRIL 3

PROGRAMME

1. Adoption of rules of procedure.
2. Arrangement of programme of questions for discussion by the Conference regarding the epidemic of pneumonic plague.

A preliminary meeting of the Delegates to discuss rules of procedure, the official programme, and other business was held in the Conference Hall on Monday, April 3, at 2.30 p. m. Dr. Wu Lien Teh was in the chair.

After a roll call of the Delegates had been taken, the Chairman stated that the proposed rules of procedure had been circulated and were now open for discussion.

After some discussion it was decided that English, French, German, and Chinese should be the official languages employed at the Conference. After consideration of each paragraph individually, of the proposed draft, the rules of procedure (see p. 12) were officially adopted by the Conference.

In response to an inquiry from the Chair, the meeting signified its agreement with the suggestion that the minutes and reports of the Conference should be published in English.

The next business was the acceptance of the general programme of the work of the Conference (see p. 14), which, at the suggestion of Dr. Strong, seconded by Dr. Martini, was left to a committee to be revised slightly. The committee for this revision, which was then elected by ballot, consisted of Dr. Martini, Dr. Galeotti, and Dr. Teague.

Discussion ensued as to whether this committee could prepare a programme for the session of the Conference upon the following day, and eventually a proposal by Dr. Broquet, seconded by Professor Kitasato, that the Conference should adjourn immediately after hearing the Chairman's address, as an act of homage to the doctors who lost their lives in Manchuria, was carried unanimously.

The Chairman's proposal that Professor Kitasato be elected

president of the section of bacteriology and pathology was adopted with acclamation.

The meeting then elected Dr. Farrar, Dr. Zlatogoroff, and Dr. Shibayama as the committee (appointed under rule of procedure 7) to arrange the daily work of the Conference.

The suggestion of Dr. Christie that Dr. Aspland, as medical secretary, should be an *ex officio* member of both of the committees elected, met with universal approval.

The following telegram from the Waiwupu was received and read:

> Ministers Waiwupu extend cordial welcome to Delegates International Plague Conference and wish great success to their discussions and investigations. Yen.

The meeting then adjourned.

RULES OF PROCEDURE

[Adopted at a special meeting of Delegates held at 2.30 p. m. on April 3.]

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1. That the work of the Conference shall be conducted in two parts—the first part to be occupied with the presentation of evidence regarding the epidemic, and the second part to be concerned with the framing of the recommendations asked for by the Chinese Government and based upon the evidence presented.

2. That the following rules of procedure shall apply only to the first part of the work of the Conference:

3. That the Chair shall be addressed as "Mr. President."

4. That when a vote is taken each delegation shall have only one vote, the means of exercising and conveying the vote to be left to the discretion of each delegation. On questions of procedure and discipline the Chairman, in the event of a vote being equally divided, shall have a deciding vote.

5. That the scheme of questions for discussion and investigation set forth in the official programme shall be adhered to, subject to modification by the addition of any points arising during discussion of which information is desired by any of the Delegates.

6. That the order of priority, when more than one report on a particular subject is read before the Conference, shall be determined by the alphabetical order of the countries whose Delegates present reports.

7. That a committee be appointed for the purpose of arranging the daily work of the Conference, both with regard to the presentation of the evidence and to the discussions upon the evidence.

8. That the number and constitution of the committee so appointed shall be decided by the Delegates, but the committee may complete its own organization.

9. That the manner of forming the committee shall be as follows: Each delegation shall hand in the name of one of its members to the Chairman, the selected Delegates shall decide upon the number to form the committee, and the committee shall then be formed, either by arrangement or by a show of hands.

10. That the committee shall furnish to each Delegate at the earliest opportune moment, after each session of the Conference, a programme announcing in order the reports to be given on the following day and the order of discussions upon those reports.

11. That the committee shall be empowered to invite guests with special experience of any phase of the epidemic to take part in the discussions.

12. That proposals by Delegates relating to any matter concerning the work of the Conference shall be handed to the Medical Secretary of the Conference. The Medical Secretary will thereupon send the proposals in a circular note to each Delegate for signature. A special meeting for the

purpose of considering the proposals will then take place at the earliest convenient hour.

13. That the minutes of the sessions of the Conference shall give a brief résumé of the deliberations, and that a copy shall be opportunely furnished to the Delegates; and the minutes shall be submitted to the Conference for confirmation and shall be taken as read at the beginning of a session, unless specially called for.

14. That the editing and publication of the report of the proceedings of the Conference shall be left unreservedly in the hands of a committee appointed by the Delegates. This committee shall be appointed in the manner described in rule 9.

15. That English, Chinese, French, and German shall be recognized as the languages to be used at the sessions of the Conference.

16. That, except when otherwise decided by the Delegates, the hours of meeting of the Conference shall be from 10 a. m. to 12.30 p. m. on every day of the week except Saturday and Sunday.

PROGRAMME OF QUESTIONS FOR DISCUSSION REGARDING THE EPIDEMIC OF PNEUMONIC PLAGUE, 1910 TO 1911

A. Epidemiology.

1. The origin of the past epidemic.
2. The diffusion of the past epidemic throughout the affected areas in relation to time and place, and the influence on its dissemination of roads, rivers, railways, and shipping.
3. The relation of animal plague to the past epidemic.
    a. Tarbagans.
    b. Rats.
    c. Other animals (pigs, dogs, horses, etc.).
4. The character of the past epidemic curves as illustrated in cities and districts.
5. The relation of the past epidemic to climatic influences, atmospheric temperature, and humidity.
6. Has there been a spontaneous decline in the past epidemic—i. e., apart from the influence of preventive measures—and, if the evidence for this exists, what is the cause of the decline.
7. Data relating to the origin of infection in villages and towns.
    a. The importation of persons incubating the disease, or of sick persons, or healthy carriers of the disease.
    b. The importation of infected clothing or merchandise.
8. The infectivity of the plague patient.
    a. The infectivity of the excreta.
    b. The range of infectivity of the patient brought about by the expulsion of plague bacilli in the act of coughing, spitting, speaking, etc.
    c. Evidence as to the possibility of transmission of the infection from plague patients to contacts by the agency of human fleas.
    d. The infectivity of corpses.
9. The infectivity of houses in which one or more plague cases occurred.
    a. Danger from the contamination of floors, *k'angs* [brick beds], food, and vessels for food, etc., by sputum of plague patients.
    b. Have fomites played any part in the spread of the epidemic (infected clothing, etc.) as agents in the spread of infection.
    c. Is dust capable of carrying infection.

d. Artificial heating of rooms and ventilation or the absence of ventilation of rooms as factors which may influence the infectivity of houses.
e. The relation of overcrowding and the habits of the people to the spread of the disease within houses.
f. The duration of infectivity of rooms or houses.

10. The question of variation in virulence of the bacillus at different stages of the past epidemic, as evidenced by the average duration of the illness, by the case mortality, and by the inoculation of animals.
11. Evidence as to natural immunity in persons exposed to infection.
12. The question of the danger of transmission of the infection to rats during the past epidemic.
    a. By the sputum of plague patients.
    b. By gnawing exposed plague corpses.
    c. By fleas and other insects.
    d. By inhalation of plague bacilli.
13. Statistical data.
    a. The death rate from the disease in different communities.
    b. Age incidence.
    c. Sex incidence.
    d. Race incidence.
    e. The incidence in various classes of the population as judged by their social condition.
    f. Occupational incidence.
    g. Incidence amongst contacts at different stages of the past epidemic.
    h. Statistics relating to the liability to infection of doctors, students, nurses, attendants, and members of the sanitary staff.
    i. Case mortality in different places.

B. Clinical Data.

1. Types of the disease met with during the past epidemic apart from primary pneumonic plague—e. g., primary septicæmic plague (?), bubonic plague (?), intestinal plague (?), primary or secondary (?), and pestis minor (?).
2. Incubation period.
3. Symptoms.
4. Diagnosis.
    a. Differential diagnosis.
    b. Bacteriological diagnosis.
        (1) The examination of the sputum.
        (2) The examination of the blood.
        (3) Lung puncture.
        (4) Spleen puncture.
5. Prognosis.
6. Treatment: Serum, vaccine, chemotherapy drugs.

C. Bacteriology and Pathology.

1. Characters of the strain of the bacillus isolated during the epidemic.
   a. Cultural tests.
   b. Agglutination tests.
   c. Toxins.
   d. Virulence.
   e. Pathogenicity to animals.
   f. Vitality of the bacillus on inanimate objects.
   g. Resistance to exposure to varying conditions—e. g., drying, sunlight, freezing, alternate freezing and thawing, etc.
2. Infectivity of the plague patient.
   a. Infectivity of the excreta.
   b. Infectivity of the breath.
   c. Infectivity of fleas and other insects parasitic on the patient.
   d. Infectivity of corpses.
3. Bacteriological diagnosis of plague pneumonia.
   a. Examination of the sputum.
   b. Examination of the blood.
   c. Lung puncture.
   d. Spleen puncture.
4. Immunity.
   a. Prophylactic inoculations.
   b. Serum-therapy.
5. Morbid anatomy especially in relation to the mode of infection in plague pneumonia.

D. Measures Employed to Combat the Epidemic.

1. Prophylactic inoculations with vaccines and sera.
   a. Evidence as to protection conferred by plague vaccines against a pneumonic infection.
   b. Evidence as to hypersusceptibility to infection immediately following inoculation with vaccine—the negative phase.
   c. The comparative immunizing properties of vaccines prepared from "rat" strains, "human bubonic" strains, and "pneumonic" strains.
   d. Local and constitutional effects produced by vaccines and sera obtained from different sources.
   e. The value of antiplague serum as a prophylactic, either given alone or with vaccines.
2. Measures to be taken to limit the spread of infection in an infected town or village.
   a. Sanitary cordon to prevent ingress of possibly infected persons or goods.
   b. Adoption of measures to limit the intercommunication of members of the community.
      (1) Closing of schools, dispensaries, churches, theaters, pawnshops, inns, brothels, factories, laundries, etc.
      (2) Stoppage of tramways, rickshaws, and other means of conveyance.

(3) Division of towns into sections, and the segregation of the inhabitants in each section by the enforcement of quarantine regulations.

c. Education of the people by means of public lectures and the issue of pamphlets and popular bulletins.

d. The establishment of hospitals.
   (1) For plague cases.
   (2) For suspect cases.

e. The establishment of quarantine camps.
   (1) Contact quarantine camps.
   (2) Segregation camps for certain classes of the community and for immigrants.

f. Notification of sick persons and corpses found in houses or streets and of coffins sold; house-to-house visitation.

g. Means of disinfection.
   (1) Disinfection of plague houses and articles suspected of being infected, including the burning of houses.
   (2) The efficacy of various disinfectants (lime, carbolic acid, perchloride of mercury, sulphur fumigation, and formalin) and the comparative value of various methods of disinfection, with special reference to the difficulties encountered in disinfection work, owing to the severe climatic conditions prevalent during the epidemic.

h. Methods of removal and disposal of plague corpses.

i. Organization of the sanitary staff.

j. Precautionary measures to be taken by those attending to the sick or concerned with the removal and disposal of the dead—e. g., inoculation with plague vaccine; baths; masks, goggles, overalls, gloves, etc.

3. Measures to be taken to prevent a widespread diffusion of infection.
   a. Sanitary cordon to prevent egress of possibly infected persons or goods.
   b. Railway quarantine of passengers and goods.
   c. River quarantine of passengers and goods.
   d. Sea quarantine of passengers and goods.
   e. Control of coolie migration.

E. The Effect of the Epidemic on Trade.

1. Bean trade.
2. Wheat and flour trade.
3. Skins, furs, human hair, etc.
4. Coal.
5. Railway traffic.
6. Other trades.

SESSION I, APRIL 4

PROGRAMME

1. Preliminary business.
2. Address of the Chairman.

PRELIMINARY BUSINESS

The Conference met at 10 a. m. The following telegrams were read:

[Telegram from the Conference to H. I. H. the Prince Regent.]

The Delegates heartily thank the Ministers of the Waiwupu for their kind greetings and good wishes. They also request their excellencies to place the following message before His Imperial Highness the Prince Regent: "The Delegates of the Plague Conference acknowledge with respectful thanks the kind message of welcome from Your Imperial Highness. They appreciate the lofty sentiments which have inspired the Imperial Government in convening this Conference, and they are one and all animated by a sincere desire to make this meeting a success." (Signed by the senior Delegate of each delegation.)

[Telegram dated April 3, received from the Harbin Antiplague Society.]

We beg to convey our respectful congratulations on the opening ceremony; we trust that you will meet with good results, which will not only prove useful to the advancement of medical science but also confer great benefits on mankind.

[Telegram dated April 3, received from the "Kwang Hwa" Medical Association of the Province of Kwantung.]

We send you our congratulations on the opening ceremony. This is the first happy occasion in the history of our country that foreign doctors have met for a conference. We trust that the plague will soon be completely wiped out to the greater benefit of mankind.

[Telegram dated April 3, received from the Russian Delegates at Harbin who have not yet arrived at Mukden.]

The members of the Russian delegation left in Harbin present to the members of the Conference and to their Chinese colleagues their sincere respects and warmest wishes of success.

Suitable telegraphic replies were sent by the Secretary to the telegrams received.

ADDRESS BY THE CHAIRMAN, DR. WU LIEN TEH

Your Excellency, Delegates, and Gentlemen, permit me to express the great pleasure it gives me in accepting the appointment as Chairman of this International Plague Conference, con-

sisting as it does of so many well-known names in the medical and scientific world. I feel very diffident in having to address such an august body, well knowing my poor qualifications, and the only reason I can think of for having this honor thrust upon me is the success of the plague preventive work in Harbin, in which, however, I seem to have had but a small share, in comparison with the arduous tasks which fell to my staff of able and willing assistants.

As His Excellency the Imperial Commissioner has remarked, this pneumonic plague sprang upon us suddenly, and, despite all our efforts, has claimed up to this date more than 46,000 victims. It seems that this form of plague is not actually new to Manchuria, as for many years, certainly within the last decade, there have been sporadic outbreaks both amongst Russians and Chinese in Siberia, Mongolia, and Manchuria. There are statements that it raged during the seventeenth century, but so far as can be gathered from really authentic records this is the first extensive outbreak of the exclusively pneumonic variety that has occurred for ages. You may be aware that the epidemic which swept over Newchwang in 1899 was mainly bubonic in character, as also was that which killed over 800 people in Tongshan in 1908. We are indebted to the Russian doctors for the first accurate information regarding epidemics of pneumonic plague, and, as full papers will be read before this Conference by our learned Russian colleagues, I will pass over that part of the subject and confine myself rather to what little we have been able to discover regarding the present outbreak. That a certain rodent, the *Arctomys bobac*, known in English as the marmot, in Russian as the tarbagan, and in Chinese as the *han ta*, is chiefly associated with this form of plague, has for some time been fully believed by the inhabitants of Mongolia and northwestern Manchuria. According to some valuable information gathered by Dr. Ch'uan, of the Chinese Medical Staff, who was sent up to the station of Manchouli to report on the subject, it appears that the local people have long been familiar with this disease, both in men and in animals. From the actual marmot hunters themselves he found out some items which, I venture to believe, will exercise an important bearing on our knowledge of the plague.

Nature is very rich in coincidences, and perhaps as scientists more than any other class of men you are prepared for such, but who could have dreamed that the healthy marmot, basking, as it loves to do, in the warm sunshine, utters a cry resembling the sound of *"Pu p'a, Pu p'a,"* which in the Chinese language, at

any rate, means "don't be afraid," or "no harm." Sickness renders it mute, so that in the light of present knowledge it would seem that when the marmot is not crying "no harm, no harm," there is very real harm indeed. The sickness in the tarbagan, which we presume is the forerunner of the plague, in this case is characterized by an unsteady gait, inability to run or to cry when chased, and, when caught, the physical signs are seen to consist principally of enlargement of the glands. When noticing the above signs the experienced hunter leaves his quarry severely alone and betakes himself to more distant spheres. During the past few years, however, there has been an exceptional demand for the marmot skins in the European and American markets, and numbers of wandering Shantung coolies have, in consequence, found their way to the marmot resorts, hunting the animal indiscriminately, and food being scarce, they have often cooked and eaten the flesh of the marmot. A number of these Shantung men have died in previous years, but not in sufficient numbers to attract attention. The season for killing marmots is from August to the middle of October. About the third week in October of last year there were said to be fully 10,000 of these hunters gathered in Manchouli and Khailar with their skins, waiting to sell them and then to return south for the winter. Dr. Ch'uan found out that the symptoms of sickness suffered by these hunters were headaches, fever, and spitting of blood-colored sputum, followed by rapid death.

The tarbagan, or marmot, has a wide range over the plains and sandy wastes of Mongolia and Central Asia, and now that such attention has been called to its power of infecting human beings with plague, we shall learn more about its habits. We know that it hibernates and awakes fat and strong in the spring, when the younger ones seek new homes in which to breed. The new burrows often run into old "earths," in which it may happen that there may be dead left from a previous season which may infect the new arrivals. The animals that die in the open are probably all devoured by birds, etc., but it seems that the marmot creeps into its home, as a rule, to die. The inexperienced hunters nearly always dig out the marmots from their holes and thus run more risks than the ordinary Mongol, who generally hunts the marmot in the open, or traps it near its abode, thus coming into contact with and catching only healthy animals. Despite the apparent risk, however, there are no statistics which show that many hunters die on the plains, but when they are gathered together in the late autumn at the market places they crowd into very poor hovels or inns, where, with piles of raw pelts, there may often be found from twenty to forty in number,

sleeping and eating, in the smallest of most badly ventilated rooms, wherein the conditions are ideal for the encouragement of an epidemic.

From Chinese sources we learn that the first case of pneumonic plague reported in Manchuria occurred in the small town of Manchouli on October 12, 1910, but owing to the energetic action of the Russian authorities only about 400 died; the last case reported was on December 25—i. e., two and a half months after the outbreak. The first cases reported in Harbin were on November 7, when two tarbagan hunters, who had arrived from Manchouli, were lodged in the shop of an artesian well mechanic. These two men died of plague, and infected four others with whom they lived. From this time forth the epidemic began to spread rapidly, and Harbin soon earned an unenviable reputation as a plague-distributing center, from whence it spread into central and southern Manchuria, and far into the northern provinces of Chihli and Shantung.

The following few dates are of interest as showing the rate at which certain centers became infected:

Place.	Date.	Place.	Date.	Place.	Date.
Manchouli	Oct. 12, 1910	Hsinminfu	Jan. 14, 1911	Kirin City[e]	Jan. 16, 1911
Harbin	Dec.[a] 4, 1910	Yungpingfu[b]	Jan. 15, 1911	Chingchowfu	Jan. 14, 1911
Shuangchengfu	Jan. 5, 1911	Chefoo[c]	Jan. 21, 1911	Tientsin	Jan. 15, 1911
Kuanchengtze	Dec. 14, 1910	Tsitsihar	Dec. 4, 1910	Peking	Jan. 12, 1911
Mukden	Jan. 2, 1911	Hulanho[d]	Dec. 13, 1910	Tsinanfu	Feb. 1–7, 1911

[a] Number of cases considerably increased.—[EDITOR.]
[b] Not on railway.
[c] By sea from Dalny.
[d] Fifteen miles from railway.
[e] Eighty miles from railway.

For the accuracy of the dates I can not vouch, but they are correct within a day or two. It is instructive to see—

(1) That the plague tended to follow the quickest line of travel.

(2) That the lines of infection corresponded exactly with the routes taken by the coolies on their return home for the Chinese New Year.

(3) That although Shuangchengfu is only about 30 miles south of Harbin, on the Russian Railway, the first case reported there was nearly two months after the outbreak in Harbin. When it did appear it was extraordinarily virulent, killing over 4,000 people in the whole district in the course of two months.

(4) That it spared certain towns—e. g., Newchwang, also Chinwangtao, the principal winter port of north China. The reason in the former case appeared to be due to the fact that the harbor is frozen in winter; in the latter case the cause might be traced to the coolies not using it on their southward march by

foot. That Tongshan actually, and Peking and Tientsin practically, escaped might be due to the employing only of local coolies in winter, and, therefore, those homeward bound from Manchuria would not remain in these cities.

As the main object of this Conference is expressed in the words of His Excellency the Commissioner, "We are determined henceforth to meet this enemy, the plague, armed with the best knowledge we can obtain," I will, therefore, venture to lay before you the following topics for your consideration: I would request you to confine your attention, as far as possible, to the present epidemic in its pneumonic, septicæmic, and other forms (if such be existent), and only to deal with the bubonic form, in so far as it throws light upon the present outbreak, and I trust that the elucidation of some of the many plague problems at this Conference will enable us more effectually to deal with it in the future.

It would be idle on my part, at this stage, to attempt in any way to deal *ad seriatim* with the many interesting problems—some of them exceedingly obscure—which have arisen out of this epidemic, but a few observations made while I was in Harbin may perhaps be of interest to you. When I first went there many of the inhabitants with whom I conversed informed me that this epidemic was quite an ordinary visitation, to which they had been accustomed. It never killed many, and would stop of itself, if no attention were paid to it. From both Russian and Chinese records there is no doubt that the pneumonic form of plague had occurred there before, but why on this particular occasion it should have assumed such a virulent form, killing, within the space of three months, over 5,000 persons in a population of 30,000, I hope you may be able to explain.

Two factors seem to have contributed largely to the virulence of the epidemic in the Chinese city. These were, first, the severe climatic conditions, the thermometer registering, at times, —30° C., which extreme cold prevented people going out of doors, and, secondly, the low, dark, dirty and overcrowded houses, which formed the majority of the dwellings. At the same time it is worthy of note that some of the double-storied houses, with plenty of air space and not overcrowded, were also badly infected. In one house, particularly, a porcelain shop, situated in the largest street, containing eight inmates including the proprietor, none of whom belonged to the coolie class, one after the other had the plague, until in the end not a person was left to claim the property.

While on this topic I should like to say a few words on the character of the epidemic at Shuangchengfu, a city situated on

the railway line, 30 miles south of Harbin. As cities are known in China, there could be no greater contrast than between Shuangchengfu and Fuchiatien (the Chinese town of Harbin). The latter is closely packed and built on a low-lying, swampy plain, with narrow streets, inhabited principally by coolies, while the former is a finely planned city with wide streets at right angles to each other, some of which are as much as from eighty to a hundred feet broad. This town is famed for its spacious compounds and large, well-constructed houses. There is much open space used by the numerous large inns, bean mills, distilleries, pawnshops, etc., and at least half of the population is well to do. There is little poverty among the people. The majority have settled and live in families, thus making a very marked contrast to the transitory hand-to-mouth multitude that forms so large a section of Fuchiatien. About half of the families of Shuangchengfu are Manchus, many of whom are wealthy landowners who, with the leading Chinese merchants, are very clean in their habits and homes. Yet there were 1,500 deaths in this city of about 60,000 inhabitants within the space of seven weeks. I cite this to show that there may be other reasons as well as dirt and poverty to account for the fierce mortality.

Turning to the subject of statistical data, full tables will in time be handed to you for your consideration. It is interesting to note that where records have been kept the age of greatest susceptibility is from 20 to 40 years. In Fuchiatien less than 100 women died out of a total of over 5,000 deaths, while in Shuangchengfu nearly 500 out of 1,500 deaths were women. This is explained by the fact that in Fuchiatien there are almost no females, while in Shuangchengfu a large part of the population is made up of families.

This epidemic found us at the beginning relying on many of the data of bubonic plague relating to prevention and treatment, but the results of our experience at Fuchiatien have tended to modify our early expectations as to the efficacy of the vaccines and serums procured by us. Another fact perhaps worthy of notice is that in Mukden alone 13,000 rats have been examined, besides large numbers in other centers, under the Chinese administration, without showing any signs of plague. It might be suggested, therefore, that few, if any, have been infected; yet in Harbin the unusually large number of deaths among domestic animals, as also the deaths of about 400 horses and 300 pigs, might suggest the possibility of a similar epidemic infection.

I regret deeply that the enormous amount of work in hand, at the time when the epidemic was raging, and our limited

number of assistants made it impossible for us to collect positive scientific facts upon this subject.

The question of natural immunity forced itself upon our consideration. Several plague-hospital assistants and attendants worked right through the epidemic in hospitals where scores were dying daily under our notice, even though the precautions taken by them were of the lightest character and were even nonexistent over long periods of time.

Two items of interest which proved their utility during the Harbin outbreak in such a manner as to have an important bearing upon any future epidemic may be alluded to: First, the use of railway wagons for quarantine work; and, second, the disposal of the dead bodies by burning.

The ease with which a railway wagon, holding at the most not more than twenty persons, enables a segregation camp to be divided into small units completely isolated from each other, also the simplicity of disinfection, the early detection of suspects, the satisfactory ventilation by small windows and sliding doors, and the heating by a central stove, suggest at once a most efficient form of quarantine which can be quickly established at any place in proximity to a railway.

The burning of the dead, which, though not unheard of in Chinese annals, still conjures up in the native mind all that is repulsive and contrary to natural feelings, yet once decided upon by the Government, was accepted by the people without complaint or hindrance.

At a time when severe frost made burial impossible, burning, by its ease and simplicity, commended itself to all of us. A pit, 20 feet square and 10 feet deep, which had been blasted by dynamite, was capable of holding 500 bodies at a time. When bodies were in coffins the wood of the coffins was sufficient for complete burning, but bodies without coffins required four pieces of wood 2 feet long by about 4 inches in diameter for each body, and upon the whole mass in the pit, kerosene oil was pumped from a fire engine at the rate of ten gallons for every hundred bodies. This, when lighted, burnt so rapidly and fiercely that little or nothing remained but ashes. The example of Fuchiatien, in this respect, was afterwards followed by neighboring towns, and the process has proved to be a satisfactory means for the disposal of dead bodies in all large epidemics.

Such an action on the part of the Chinese Government in dealing with the great problems of the plague, and its permission to conduct post-mortem examinations upon unclaimed bodies for the further investigation of the disease, granted for the first time in the history of China, must prove to you that the Govern-

ment is moved by the highest motives of humanity, and is ready to lay aside age-long prejudices, to spend money unsparingly, and to possess itself of all that science can impart for the saving of life and the elimination of national perils.

In closing, may I remind you that this is the first International Medical Conference held in China, and it is impossible to estimate its widespread effects. Besides the beneficial results of your observations and resolutions on the subject of plague, the impulses you will set in motion, by the fact of this Conference, will react not only upon the national life but more particularly upon the future progress of medical science in China, and I feel deeply the burden of the honor placed upon me in being Chairman of this medical conference, which is unique in our history, powerful in its representation, and which gives China a strong position among nations seeking the welfare of their people.

The Conference then adjourned until the following morning as an act of homage to the doctors who had lost their lives from plague in Manchuria during the epidemic.

SESSION II, APRIL 5

PROGRAMME ARRANGED FOR THE DAY

A. Epidemiology.
   1. The origin of the past epidemic.
   2. The diffusion of the past epidemic throughout the affected areas in relation to time and place, and the influence on its dissemination of roads, rivers, railways, and shipping.
   3. The relation of animal plague to the past epidemic.
      a. Tarbagans.
      b. Rats.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Some observations on the origin of plague in Manchouli; discussion.
3. The history of the spread of plague in north China.
4. Epidemiology of the plague in southern Manchuria; discussion.
5. Epidemiology of plague in Manchuria; discussion.

PRELIMINARY BUSINESS

At the suggestion of the Chairman, Mr. Lauru was appointed official secretary and Mr. Woodhead official stenographer to the Conference.

The Medical Secretary then read the following telegram:

"The Medical Missionary Association of China, composed of over 300 European and American medical members, conveys hearty congratulations on the inauguration of the first International Medical Conference held in China, and wishes the Delegates every success in their important work."

The Medical Secretary also stated that an extensive communication had been received from the Swedish Minister in Tokyo, relating to plague prevention work as it refers to ports, shipping, etc. It was a very extensive communication, and he suggested that it be left on the table for any who chose to read it, as the work of the Conference really covered the ground upon which information was asked.

The Secretary read the following telegram, dated April 4, received from the Antiplague Bureau in Harbin:

"The members of the Antiplague Bureau of Harbin beg to transmit to the representatives of the medical and scientific world their hearty greetings, and hope that they will discover the means of wiping out this most deadly enemy of humanity."

The Chairman. Gentlemen, with your permission, I will ask the Secretary to send suitable replies to these communications. The third item for us to consider is the question of admitting members of the medical profession

to all our sessions except business meetings. I lay this proposal before the delegations. It seems that this Conference is being held with the object of learning as much as possible from the experts of different countries, and, as some of us are also not full Delegates, perhaps it would be fitting and it would also be the desire of the Conference to admit members of the medical profession and others who have worked in connection with plague to our sessions, excepting the business meetings. I put this to the delegations and ask their opinion.

Dr. G. D. GRAY. Is not that covered by rule 11 (see p. 12) of the rules of procedure?

The CHAIRMAN. That rule really refers to persons who are invited to attend the Conference. The question is whether medical practitioners are to be allowed to attend the discussions of the Conference.

Dr. R. P. STRONG. I move that your proposal be accepted, Mr. Chairman. I should like to add that members of the medical profession and others who have worked in connection with the epidemic be allowed to attend all meetings of the Conference, except business and special meetings.

Dr. G. D. GRAY seconded this proposal.

This resolution was placed before the Conference and declared carried *nem. con.*

The CHAIRMAN. The next business is the question of propositions and amendments. It is suggested that the questions should be handed in in writing to the Chairman.

Dr. ASPLAND. The object of this suggestion is to assist the compilers of the reports. Instead of having resolutions proposed by word of mouth only, it is suggested that they should be handed in in writing to the Chairman at the time they are made.

The CHAIRMAN. If that is agreed to we will proceed to the next business, namely, the confirmation of the minutes of the previous meetings.

On motion the minutes of the previous meetings were accepted.

The report of the programme committee, consisting of Drs. Martini, Galeotti, and Teague, suggesting several amendments in the official programme (see p. 14), was also accepted.

The scientific programme was then taken up, the first paper presented being upon

SOME OBSERVATIONS ON THE ORIGIN OF THE PLAGUE IN MANCHOULI

By Dr. CH'UAN SHAO CHING

Manchouli,[1] the western terminus of the Chinese Eastern Railway, is a small town about 530 miles northwest of Harbin. It is about 10 miles east of the boundary line between Manchuria and Siberia. Only some 200 houses are owned by Russians, and all these are built within the railway area. The normal population consists of 5,000 Russians and 2,000 Chinese, but during the marmot-hunting season—i. e., from the end of the third moon to the ninth moon [April to October]—the Chinese population is increased to the number of about 10,000.

The town was declared to be infected with plague pneumonia from the 10th day of the ninth moon [October 12] until the 24th

[1] Manchuria station.

day of the eleventh moon of last year, [December 25] (1910). Three hundred and ninety-two deaths from plague were officially registered during this period. With the exception of two Russian doctors in charge of the quarantine wagons and a Russian woman and her son, aged 10, who lived in a marmot-skin store, all the deaths occurred among the Chinese.

Observations reported to me by Chinese residents show that two carpenters who lived in the house adjoining Wu Kuei Ling's inn died with spitting of blood on the 10th day of the ninth moon [October 10]. These two carpenters had been in the service of a foreman named Chang Wan Shun at Dawoolya, a railway station in Siberia situated some 6 miles west of the boundary line. Chang Wan Shun told me that six or seven of his carpenters had died with blood spitting in Dawoolya on the 13th day of the eighth moon [September 16], and said he believed that plague had appeared in Dawoolya before it was known in Manchouli. The carpenters and marmot hunters who lived in Dawoolya contracted the infection there, in his opinion, and carried it to Manchouli.

Later on it was found that nine out of twenty coolies, who lived in a small room in Wu Kuei Ling's inn, were suddenly taken ill with blood spitting. One of them was sent to the Russian Railway Hospital, and it was discovered that he suffered from pneumonic plague. Two died in the house that same night, but the rest ran away to different places in the town, and thus disseminated the disease.

I called upon Dr. Brisemsky, the Russian railway doctor at Manchouli, who kindly supplied me with the following information:

1. Cases of plague were discovered in Manchouli in 1905 and 1906, but fortunately those outbreaks were limited, and only a few of the cases died.

2. Centers of plague have long been known in the district around Manchouli. Professor Zabolotny has twice visited this region, and has studied carefully the disease both in men and marmots.

3. In marmots, plague is a chronic disease characterized by the formation of tubercles in the lungs.[1]

I was informed that the marmot-hunting area covers some 15,000 square miles in the conterminous parts of Manchuria, Siberia, and Mongolia. The marmots are free from plague in

[1] This conclusion was based apparently upon the discovery of a single diseased tarbagan, which on examination was found to show chronic lesions containing bacilli morphologically identical with the plague bacillus.—[EDITOR.]

the spring, as the infected ones die out in the winter. The healthy animals desert the infected burrows and make new ones, but during the breeding season in summer the young ones dig new holes and often find their way into the old holes, some of which may have retained the infection from the previous winter. Hence it is only in the autumn that the infection spreads among these animals.

The hunters appear to have a very trying time on the hills. Often they fail to get anything to eat or to drink. Consequently they eat the flesh of the marmot and drink water squeezed out of a towel which has been left on the grass during the night in order to catch the dew. Hunters under such circumstances are naturally weakened in their physical constitution, and are thus predisposed to any infection. On their arrival at Dawoolya, Manchouli, or other towns they are packed in rooms somewhat like sardines in a box and thus easily contract and spread plague. Hence it is believed that the present epidemic had its origin from the marmot.

I had several talks with the marmot hunters and inquired whether they knew of the occurrence of any cases of sickness, such as blood spitting or of sudden death, during their hunting season on the hills. They replied that they had never known of such cases either on the hills or on their return journey, and that only at Dawoolya, Manchouli, or other towns did the plague attack the marmot hunters and others.

According to the hunters' accounts the marmots are very crafty and are always watchful against the attacks of men or animals, but when they are affected with plague they become deaf, their eyes red and partially blind, their paws bloodless, and they creep along slowly and unsteadily. The sick animals are often expelled from the holes by the healthy ones, and consequently have to wander about aimlessly until they die or are killed on the plains.

The hunters acknowledge that they can readily recognize the diseased marmots, but, owing to the high prices which the skins fetch, they nevertheless hunt them and sell their skins.

It is interesting to note that the hunters profess to diagnose the disease in the freshly killed marmots by making a slit in the paws. If these bleed the animals are considered to be healthy, while if there be no oozing of blood they are regarded as diseased. Another fact of value in diagnosis and one well known among the hunters is that the marmot when in a healthy condition is difficult to catch, rushing about vigorously and uttering a cry "*Pu p'a,*" which in the Chinese language means "don't fear," but

that when sick it makes for its burrow, so as to avoid its enemies, with a distinct inability to run or even to cry out when being killed. The hunters have noticed that the sick ones when caught have large swellings in the groins, etc.

I made some observations on the types of dwellings occupied by these hunters when they return from their work. They are built of strong timber laid out in small blocks of one story in height. Into each compartment from twenty to forty bunks arranged in three or four tiers may be seen. The windows are seldom if ever opened, and when the rooms are crowded during the hunting season the smell emanating from the occupants and from the raw skins which they often bring with them is not pleasant, and probably paves the way for infection in epidemic form.

I have to acknowledge my thanks to Dr. Brisemsky and to others who have so kindly furnished me with valuable information.

DISCUSSION

The CHAIRMAN. This subject is now open for discussion.

Professor ZABOLOTNY said that the question as to whether the infection originated through the medium of the tarbagan was an open one, and, although there seemed to be every probability that this supposition was correct, the Conference must approach the matter with an open mind.

Professor KITASATO agreed with Professor Zabolotny. They had found that bubonic plague was always caused by rats. That had been proved in Japan and in India, but the responsibility of the tarbagan in originating human epidemics must be discussed as a supposition that required proof.

Dr. PETRIE asked Dr. Ch'uan whether he had obtained any evidence indicating the occurrence of any bubonic cases in the beginning of the epidemic in Manchouli.

Dr. BROQUET indorsed the views of Professors Zabolotny and Kitasato and considered that the question should be studied very carefully, as it had not yet been proved with certainty that the tarbagan was able to cause pneumonic plague. In India and in Europe there had been epidemics of pneumonic plague which were not associated directly with plague in animals. A thorough investigation of this point should be made in order to arrive at a definite conclusion.

Dr. GRAY pointed out that the discussion of this point really came later on the programme.

Professor SHIBAYAMA stated that he had made experiments

with a single small species of marmot [1] and he had found it was not so susceptible to plague as the rat. He had given it a subcutaneous injection of one thousandth part of a loop, and the animal died seven days later. At the post-mortem examination he found very few alterations in the internal organs, but there were some nodules in the liver and spleen.

Professor ZABOLOTNY said that during the last epidemic at Odessa they had found chronic plague among rats. In the case of the tarbagan there was a chronic form of plague also. He had known of a case similar to the one described by Professor Shibayama. He thought that chronic plague appeared among tarbagans in the same way as among rats.

Dr. PETRIE asked whether the tarbagan infected by Professor Shibayama was inoculated with a pneumonic strain from the recent epidemic.

Professor SHIBAYAMA said that the animal was infected with a Harbin strain.

Dr. BROQUET said that it would also be interesting, if possible, to find whether there was any parasite on the tarbagan that was able to convey plague in the same way as rat fleas. We know nothing about the parasites of the tarbagan.

The CHAIRMAN. I wish to ask the Delegates whether it is their desire that we should go on with the discussion of Dr. Ch'uan's paper, because we have upon our programme all these questions regarding insects, etc. In my opinion it would, perhaps, be better to confine ourselves to the discussion of the paper read by the previous speaker. Do you not think it better to leave other questions until the time when a paper upon them is under discussion? If there is nothing more to be said, I will call upon Dr. Gray.

Before Dr. Gray gave his address, Dr. Ch'uan stated that his answer to Dr. Petrie's question relating to the existence of bubonic cases in Manchouli was in the negative.

The next subject considered was

THE HISTORY OF THE SPREAD OF PLAGUE IN NORTH CHINA

By Dr. G. D. GRAY

Dr. GRAY said that he had not had time to prepare an address on the subject, but he would try to give a general idea of the

[1] *Spermophilus citillus* (Linn.). This species is common about Mukden and is very much smaller than the Mongolian tarbagan *Arctomys bobac* Schreb.—[EDITOR.]

origin of the epidemic and the course it had followed by rail, road, and river. With the aid of a map (see Plate XV) he then traced the progress of the epidemic by railway from Manchouli. Tsitsihar, a nonproductive town, became badly infected. The main factor in the spread of the epidemic had been the railway, by which the disease had swept onward from Tsitsihar to Harbin, Changchun, Mukden, and to other places. The infection was carried by road to Petuna, a big town distant from the railway. The progress of the epidemic had been traced from police reports, the police informing the authorities of the movements of affected persons from village to village. The spread of the plague along the road had been chiefly due to Shantung coolies returning home. Kirin had been infected from two sources, in each case by a cart driver, one coming from the north and the other from Changchun. In Shanhaikuan there was a small epidemic of about 16 cases. About ten days later a pointsman was suddenly taken ill near the opening of the Great Wall. He was one of eight pointsmen, and lived in a house by himself. The only feasible explanation of this case was the supposition that he had harbored a returning coolie for the night. At Tongshan, a big mining center, there was no outbreak, because the returning coolies did not pass this way. At Tientsin the first case was a man of the merchant class in the Austrian concession. At Peking a small outbreak was caused by a man of the merchant class, who was traced all the way down from Harbin. He arrived in Peking on January 10, fell ill two days later, and died after two days. The speaker then proceeded to trace the railway communications about Peking, and pointed out that the branch line connecting the Tientsin Railway with the Peking-Hankow Railway might very well have carried infection to Hankow without bringing it to Peking. The plague did not spread to any great extent in Tientsin, cases being so few and far between that the authorities were able to cope with them. A party of six men arrived at Hochienfu from Tientsin, and then separated into parties of three. A man belonging to one of these parties died at Poyehsien just after arrival, and infected both his friends. The second party hearing of the disaster came to see them, and to be present at the funeral. These three men also got infected. Dr. Lewis, a medical missionary of Paotingfu, made a thorough tour of this district. In one instance 52 deaths were distinctly traceable to infection from one man. In two small villages elderly physicians of the old school had died after visiting plague cases. At Liasien Dr. Lewis found a man who stated that he was the only adult survivor, over thirty of his family having died. Next

morning, when Dr. Lewis returned to this village, he found the man spitting blood. It was then five days since any death had occurred at the village, but this man had nursed the last case. Dr. Lewis found *Bacillus pestis* in his sputum before he died. Three days later four of the man's young children died, thus exterminating the whole of that small hamlet.

Rivers could be excluded in the spread of this epidemic, as from May to April the Sungari, for example, was frozen over and was not used as a highway by the people. The Liao River was used by a few junks in the summer, but was becoming less and less used because of the proximity of railways, and could also be put out of account. To conclude, there was a very definite spread by railway, none to speak of by river, and a fairly definite spread by road during the recent epidemic.

A paper was then read upon

THE EPIDEMIOLOGY OF THE PLAGUE IN SOUTHERN MANCHURIA

By Professor D. K. KASAI

The first information of the outbreak of pneumonic plague was received in October, 1910. Soon afterwards it was learned that the plague had spread from Manchouli to Dalai Nor, Hailar, Fuchiatien, and Harbin. The Japanese Government at once sent specialists to the scene to investigate the outbreak. It was soon definitely ascertained that the epidemic was one of pneumonic plague. Quarantine buildings were at once constructed in Changchun, Mukden, and elsewhere. From November 20 a regular system of inspection of all classes of passengers on the railway was instituted, Chinese and coolies being especially examined. The first case at Changchun occurred on December 31, although plague had been expected there earlier. The infection was imported in the person of a Chinese from Harbin. Up to February 4, 229 coolies in the Japanese railway zone were infected. Plague was introduced into various districts by travelers and carried on by other travelers. The management of the epidemic was rendered easier by the circumstance that the plague was chiefly spread by the numerous coolies who were on their way to Shantung for the Chinese New Year by way of Dairen and Chefoo. The inns became overcrowded and contributed to the spread of the disease. It was proved that pneumonic plague was very infectious, but it was also apparent that Chinese in good circumstances did not contract it readily. It could be stated as fact that the migration of coolies returning home for the Chinese New Year was the principal cause of the diffusion of the infection.

In elucidation of his paper Dr. KASAI then showed the following charts explanatory of the statistics of the epidemic in South Manchuria:

Data of the first plague cases in the localities named

Place.	Date.	Plague patients.
Changchun	Dec. 31, 1910	From Harbin; railway passenger.
Kungchuling	Jan. 15, 1911	From Changchun; the invalid was traveling per Chinese car.
Szupingchieh	Jan. 9, 1911	
Changtu	Feb. 5, 1911	From Changtu (City).
Kaiyuan	Jan. 15, 1911	
Tiehling	Jan. 8, 1911	From Harbin; railway passenger.
Mukden	Jan. 4, 1911	From Kirin; railway passenger.
Fushun	Jan. 22, 1911	From Mukden; the invalid came on foot.
Penhsihu	Jan. 23, 1911	Do.
Chikuanshan	Jan. 16, 1911	From Fuan; railway passenger.
Liaoyang	Feb. 6, 1911	From Mukden; the invalid came on foot.
Chingchow	Jan. 23, 1911	From Dairen; railway passenger.
Dairen	Jan. 4, 1911	From Harbin via Changchun, per railway.
Lushun	Jan. 20, 1911	

Number of plague cases in South Manchuria

Place.	Inside the Japanese police and railway districts.	Outside the Japanese police and railway districts.	Total.
Changchun	105	2,390	2,495
Kungchuling	13	22	35
Szupingchieh	5	1	6
Changtu		193	193
Kaiyuan	2	56	58
Tiehling		98	98
Mukden	13	1,992	2,005
Fushun	18	64	82
Penhsihu	1	18	19
Chikuanshan	1		1
Liaoyang		36	36
Dairen	66		66
Chingchow	3		3
Lushun	2		2
Fakumen		145	145
Hsinminfu		620	620
Total	229	5,635	5,864

DISCUSSION

Dr. GRAY asked Dr. Kasai if he had made any observations in regard to the spread of plague by small boats sailing from Dairen. There was a village called Lungkow on the Shantung Promontory whither plague was reported to have been carried by coolies who

chartered junks because they were unable to go by steamers. Several outbreaks in other places had been attributed to the same cause.

Dr. Kasai replied that he was unable to supply any information upon this point.

The next paper submitted was upon

THE EPIDEMIOLOGY OF PLAGUE IN MANCHURIA

By Professor D. Zabolotny

Professor Zabolotny first dealt with the route of the infection in plague. It was well known that plague was endemic in Mongolia and Manchuria since 1898. That had been bacteriologically proved. The infection, both in the bubonic and pneumonic form, spread along the railway in the Province of Manchuria. Both types were prevalent in the winter season and generally ended in the spring. It was known that pneumonic plague was carried only from man to man. During the recent epidemic rodents had taken no part in its spread. There were three methods of conveying the germs from one person to another. The first was through the particles expelled in the course of breathing. The second was through what Flügge called *Tröpfen* infection, by means of small particles of mucus. Experiments had been made to prove that the bacilli could remain alive in mucus. Dr. Zlatogoroff had mixed plague cultures with a serum of high agglutinative power and let them dry, and had found that the bacilli would remain alive for weeks. The third means of infection was by means of the sputum itself. By the cleaning up of soil and floors it would be converted into dust, and thus the infection could be spread about. As regards the manner in which the bacilli infected the lungs, they first affected the tonsils and then passed through the lymphatics to the lungs. This was stated to be a fact by Dr. Koulecha, who had proved it microscopically and by a series of sections. Perhaps the tarbagan had something to do with the initial cases, but it had nothing to do with the propagation of the disease among human beings afterwards. The tarbagan might have had something to do with starting the epidemic, but that had not yet been proved bacteriologically. He would reserve his views on the virulence and on other matters relating to the bacillus until these questions were discussed in the bacteriological section.

Finally, he enumerated the following five conclusions he had arrived at as the result of his investigations of the subject:

1. Bubonic and pneumonic plague, as verified bacteriologically, have been endemic in Mongolia and Manchuria since 1898.

2. Pneumonic plague prevails during the autumn and winter months.

3. The principal cause of the origin of the epidemic is the agglomeration of people in houses under unsanitary conditions.

4. Overcrowding, by favoring the inhalation of infective matter, plays the principal rôle in the spread of pneumonic plague from man to man.

5. The question of plague in tarbagans must be studied bacteriologically.

DISCUSSION

Dr. STRONG. I have been much interested in what Professor Zabolotny has just said. There are, however, two points I should like to touch upon. The first is in regard to droplet infection. I can indorse his views upon that point. We have performed experiments which appear to show that during the epidemic the method of droplet infection was probably the common one. On the other hand, we were able to show that, during ordinary breathing, pneumonic plague cases did not expel plague bacilli into the surrounding atmosphere. These experiments will be reported upon in the bacteriological section. With regard to the primary point of infection, usually being the tonsil, our experience also has been different. In twenty-five cases we found that, in all but one, primary infection was in the bronchi. In only one case did the tonsil show macroscopic areas of necrosis. In this one case the infection was probably secondary, primary infection being in the bronchi and lungs.

Professor ZABOLOTNY replied that he did not mean to say that infection invariably entered through the tonsils, but that Dr. Koulecha had found some cases where infection had entered through the tonsils.

Dr. KOULECHA confirmed this statement.

Dr. MARTINI. I have made some experiments upon this point. I have allowed rats, guinea pigs, rabbits, and cats to inhale plague bacilli, and I found that they developed primary pneumonic plague. Of course I found the bacillus in the glands, spleen, liver, etc., in every case, but, in comparison with the lungs, the organisms were scanty in number. We never miss them in the glands, because with every pneumonic case is also present septicæmic plague, and if you find the bacilli in the blood you must also find them in the glands and tonsils. In my opinion we must call these cases primary pneumonic plague.

Professor ZABOLOTNY said that he had seen cases in which there were masses of microbes in the tonsils and the glands, and, in addition, had made experiments bearing on the point. A

culture was injected into the tonsils of a monkey, and this injection was followed by inflammation of the glands, and in these glands he had found masses of plague bacilli. In addition to the plague tonsilitis, he found pneumonic plague and bacilli in the glands.

Dr. MARTINI said that he believed that to be quite true. More would be known about this subject if the medical men could have more post-mortems than they had obtained heretofore in China.

Dr. FUJINAMI agreed with Dr. Koulecha that microscopical examination was very important. He had found one case where the glands in the neck were very much swollen with hæmorrhagic lesions, but the lungs showed very few alterations. He had found many bacilli in the glands. This case was one of primary bubonic plague, with possibly a slight secondary plague pneumonia. The Japanese had had a large experience with bubonic plague, and in many cases they had found very few lesions in the glands and tonsils, while in the pneumonic cases they had found great alteration in the bronchi and lungs, with masses of bacilli. No one could say in regard to every case where the infection began. He had come to the conclusion that inhalation was the most frequent mode of infection.

Dr. STRONG. I quite agree with the two gentlemen who have spoken in regard to the two types of infection. I have seen the tonsillar type in other epidemics of plague; it is not so uncommon, particularly when cervical buboes are present. Probably the primary tonsillar type has sometimes occurred in this epidemic. However, in practically all of the cases we have seen, the primary infection was not in the tonsils but apparently in the bronchi.

Dr. BROQUET. For a long time writers on plague have put forward the hypothesis that in cases of bubonic plague with cervical buboes infection has been produced primarily in the tonsils. I saw at Saigon two cases of bubonic plague in which the tonsillar infection was accompanied by false membranes, but, as I found the bacillus only in the buboes, I could not affirm that entry was through the tonsils. I think that the question is an open one, and will be determined by further bacteriological and pathological investigation.

Dr. PADLEVSKY said that they had had a case of pneumonic plague at Kronstadt. The post-mortem examination revealed swollen bronchial glands. He thought this had some bearing on what was being discussed.

Dr. GRAY said that it had been mentioned that in Manchuria bubonic plague usually started in the winter. Yingkow had been mentioned as a place where a bubonic epidemic had occurred in the winter. His experience had been, however, that in these

latitudes bubonic plague arose in the summer. The Newchwang epidemic began in July. In Mongolia it occurred during July, August, and September.

Dr. MARTINI said that his recollection was that in Egypt pneumonic plague started in November and came to an end about May, when bubonic plague began. The outbreaks of bubonic plague depended upon the increase in the rat population.

The Conference then adjourned until the following day.

SESSION III, APRIL 6

PROGRAMME ARRANGED FOR THE DAY

C. Bacteriology and Pathology.
1. Characters of the strain of the bacillus isolated during the epidemic.
   a. Cultural tests.
   b. Agglutination tests.
   c. Toxins.
   d. Virulence.
   e. Pathogenicity to animals.
   f. Vitality of the bacillus on inanimate objects.
   g. Resistance to exposure to varying conditions—drying, sunlight, freezing, etc.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Characters of the strain of the bacillus isolated during the epidemic; discussion.
3. Other papers on the subjects given in the programme above.

PRELIMINARY BUSINESS

The Secretary read the telegraphic replies which had been sent in the name of the International Plague Conference to the Harbin Antiplague Society, the Kwang Hwa Medical Association of the Province of Kwantung, and the Russian Antiplague Bureau, Harbin, thanking them for their kind wishes and messages.

The minutes of the preceding meeting were confirmed.

Dr. Farrar then proposed and Dr. Martini seconded the proposal to proceed the following day to sections 2, 3, and 5 of "Bacteriology."

Dr. Farrar stated that in making up the programme for each day it was not always easy to reconcile the conflicting interests, and that sometimes papers were not ready for presentation. It seemed to be convenient to many that the meeting the following morning should be devoted to "Bacteriology" instead of "Epidemiology." In that case the ordinary course would be to proceed with the bacteriological programme. This change, however, brought another question into consideration. "Morbid anatomy" came last upon this programme, and one of the Russian Delegates who wished to read a paper upon this subject was obliged to leave the following Monday. Therefore, if the Conference was to hear Dr. Koulecha's paper it must try to consider the subject of "Morbid anatomy" the following day. He was afraid that the course proposed would not be convenient to everyone, but it was very difficult to reconcile everyone's interest.

Dr. GRAY said that although they would all like to hear Dr. Koulecha's paper it would be rather a pity to jump to the end of the programme in this way. This paper would be followed by remarks or papers on this subject from other Delegates. He really thought that it was very necessary to adhere to the programme as far as possible, and, if Dr. Koulecha was leaving, he could leave his paper to be read for him.

Dr. KOULECHA said that he could not leave his paper. It must be read by himself. It was very important also that he should exhibit his own preparations.

Dr. FARRAR suggested that, perhaps, it would be convenient to take Dr. Koulecha's paper out of its order on the following day. The paper could then be discussed later on. He then proposed that to-morrow's proceedings open with a paper by Dr. Koulecha, not to be followed by discussion, and that the Conference should then proceed to sections 2 and 3 of the bacteriological programme.

Dr. ASPLAND suggested that after Dr. Koulecha's paper had been read the Conference should proceed with the next section of "Epidemiology."

Dr. FARRAR said that he was quite willing to accept that suggestion, and altered his resolution to read "that the work for to-morrow shall be a paper by Dr. Koulecha, to be read but not to be followed by discussion, and that after that the Conference proceed with the next part of the programme on 'Epidemiology,' in due course."

This was seconded by Dr. STRONG, and was passed.

The CHAIRMAN: It is now my pleasant duty to introduce to you Professor Dr. KITASATO, who will take the chair during the discussions upon bacteriology and pathology.

The CHAIRMAN (Dr. KITASATO). We have now reached the most important part of the Conference, namely, the sections on bacteriology and pathology, and I think it would be best to enter upon their discussion at once.

Professor ZABOLOTNY proposed and Dr. MARTINI seconded a proposal that on the occasion of the first meeting of the bacteriological and pathological section an appropriate telegram should be sent to the Koch Institute and to the Pasteur Institute. This motion was unanimously carried.

The CHAIRMAN then called upon Professor Zabolotny to open the discussion upon subsection 1.

CHARACTERS OF THE STRAIN OF THE BACILLUS ISOLATED DURING THE EPIDEMIC

By Professor ZABOLOTNY

Professor ZABOLOTNY said that this epidemic was of special interest because the pneumonic type of plague prevailed throughout. It was a question whether the bacillus giving rise to the epidemic was the same as in the case of bubonic plague or whether it was a special strain. He had studied plague bacilli

from Africa, East Asia, Europe, Astrakhan, the Volga, and South America, and in many different epidemics, and now the pneumonic strain was being investigated in Harbin and in Manchuria. Their investigations had not yet been finished; however, what had been learned already was probably of great interest. With other strains of bacilli isolated from bubonic cases the bouillon became turbid, but in the case of the Harbin pneumonic strains the bouillon remained quite clear, and the bacilli fell to the bottom of the media. The virulence of the pneumonic cultures was different from the bubonic ones. Dr. Zlatogoroff had succeeded in producing very quickly a kind of septicæmia in guinea pigs with the Harbin pneumonic strains, but he had not obtained typical buboes. While guinea pigs experimented upon with the organisms isolated from other epidemics of plague died in seven to eight days, with the organisms isolated in this epidemic they died more quickly, and septicæmia was mostly found. The specific serum from Paris, Berlin, and St. Petersburg gave different results in relation to agglutination with the pneumonic strain. Perhaps this could be explained by the fact that the standard of the different serums was not the same for every culture. The results in agglutination were different in cultures obtained fresh from the pneumonic corpses and from those bubonic strains which had been grown for a long time in artificial media in the laboratories. The minimum lethal doses for guinea pigs were smaller with the fresh cultures. He had been able to make a comparison of the pneumonic strains with only one fresh culture of bubonic plague. The other tests he had had to make with old strains of bubonic plague that had been grown over a long period in the laboratory. The one fresh bubonic culture he had used came from Odessa, where there was always bubonic plague, but, so far as he could remember, there had been no case of plague pneumonia in Odessa. This strain gave on inoculation in rats and guinea pigs very characteristic buboes. The strain from Harbin on injection gave rather a septicæmia than fully developed buboes. While the investigations on this point were not yet concluded, nevertheless what had been discovered might account for the short period of the sickness observed clinically during the epidemic. Trejeshensky, in eleven cases, had isolated plague bacilli from the blood of the pneumonic cases. Practically the same result had been stated by Dr. Strong, who had found the bacillus in the blood in many cases. The recent epidemic had been of a specially septicæmic character, the pneumonia terminating by septicæmia.

DISCUSSION

Dr. BROQUET stated that he had noticed also that the culture on agar-agar of the Harbin strain was more agglutinous than one of a bubonic strain from Saigon.

Dr. ZLATOGOROFF stated that he had studied forty other strains of plague bacilli from different epidemics from various countries and twenty Harbin strains, but he had not found any difference in the growth on agar. He had only found the difference which Professor Zabolotny had described with regard to the growth in bouillon cultures. All bouillon cultures in which the bouillon became turbid showed that the organisms were in short chains, and the ones which remained clear and in which the bacteria fell to the bottom showed that the bacilli were in long chains. In gelatin cultures he observed no difference in the growth. Only the virulence of the organism in this epidemic was different. If he gave half an agar culture to a guinea pig subcutaneously it would die in thirty-six hours, and only very small buboes would be found, but acute septicæmia was present. Other bubonic strains killed a guinea pig in six to eight days, and caused characteristic buboes. That was the only difference between the Harbin cultures and other bubonic cultures. Perhaps other differences would be found if one experimented with monkeys.

Dr. STRONG. I would like to ask Professor Zabolotny if he never obtained typical buboes in guinea pigs by means of cutaneous infection with the Harbin strain. In the experiments performed in Mukden with guinea pigs we have found that by cutaneous infection of guinea pigs with the pneumonic strains these animals died after from three to six days or longer, often with well-developed buboes, but without marked changes in the lungs. Septicæmia was present. In mice also the subcutaneous injection of the pneumonic culture in small amounts gave rise to septicæmia and buboes, but not always to lesions of the lungs. The dose of half an agar culture employed by Dr. Zlatogoroff was very large for comparison in relation to virulence. Our experience has been the same as that of Dr. Zlatogoroff, in regard to growth on agar, in that we have observed no difference in growth and in relation to mucus production, etc., in about one hundred freshly isolated cultures.

Professor ZABOLOTNY said that in cases of infection of guinea pigs with the Harbin strain he had found buboes, but not such characteristic ones as with other bubonic strains. Dr. Strong

had spoken about cutaneous infection, but he had only spoken of subcutaneous infection.

Dr. MARTINI said that he could confirm Dr. Strong's observations. Cutaneous infection gave very good buboes, about the size of a pea or bean, with hæmorrhagic lesions, with the Shantung pneumonic strain, which he believed was the same as the Harbin strain.

Dr. HAFFKINE said that Dr. Mischefsky had made experiments with cutaneous infection at Harbin, and had obtained the same results as Dr. Strong. Dr. Mischefsky had infected a guinea pig which developed buboes and died on the fifth day after inoculation.

Professor ZABOLOTNY repeated that investigation of this particular point had by no means been finished. He could only state what he had seen, and the whole situation was not quite clear. There must be further and more thorough investigations. He did not know whether it had been satisfactorily proved that Dr. Mischefsky's guinea pig had died from plague.

Dr. PETRIE stated that in India the Plague Research Commission had worked with a very large number of strains of rat and human plague and had inoculated guinea pigs with them. Their experience had been that these strains were extremely virulent to the guinea pig and frequently killed them, when given subcutaneously, in two or three days. On the other hand, these plague cultures when inoculated cutaneously invariably produced a bubo. He believed that recently isolated human and rat strains were extremely virulent and frequently produced septicæmia without any definite bubo formation when inoculated subcutaneously into susceptible animals.

Dr. BROQUET. The result of this discussion and of the work published by others upon this subject is that we can not compare infection in rats in which buboes have resulted from natural infection with infection in guinea pigs in which buboes have resulted from such comparatively severe artificial infection. Therefore it is difficult to measure the defensive reaction of the guinea pig.

BACTERIOLOGICAL INVESTIGATIONS WITH THE PNEUMONIC PLAGUE BACILLUS

By Dr. SHIBAYAMA

Gentlemen, I should like to talk for a short time about some bacteriological investigations carried on in relation to the present plague epidemic in Manchuria.

The strains investigated were as follows:

1. *Strains investigated*

a. Harbin strain of pneumonic plague.
b. Changchun strain (I) of pneumonic plague.
c. Changchun strain (II) of pneumonic plague.
d. Mukden strain of pneumonic plague.
e. Dairen strain (I) of pneumonic plague.
f. Dairen strain (II) of pneumonic plague.
g. Culture from dog (pneumonic plague).
h. Culture from donkey (pneumonic plague).

2. *Morphological and cultural peculiarities*

It is quite unnecessary to speak about the morphological and cultural peculiarities of the plague bacillus in general, as these are quite well known. So the microscopic report and conditions of growth on different artificial culture media may be passed over. However, it may be stated that the bouillon cultures were slightly different from those of bubonic strains; that the production of mucus was greater.

3. *Virulence*

Tests of virulence with 48-hour agar cultures of plague bacilli isolated from cases of pneumonic plague gave the following results:

a. *Mice*

[Weight, 10 to 13 grams.]

Dose.	Inoculation.	Dairen strain I.	Dairen strain II.	Changchun strain.	Harbin strain.
		Death after—			
		Hours.	*Hours.*	*Hours.*	*Hours.*
1/100 loop	Subcutaneous	10	17	17	10
1/500 loop	do	17	10	23	10
1/1,000 loop	do	17	40	17	17
1/5,000 loop	do	20	17	10	17
1/10,000 loop	do	40	40	10	17
1/50,000 loop	do	17	10	17	17
1/100,000 loop	do	24	30	24	20
		Days.	*Days.*	*Days.*	*Days.*
1/1,000,000 loop	do	3	3	3	3

b. *White rats*

[Body weight, 100 grams.]

Dose.	Inoculation.	Dairen strain I.	Dairen strain II.	Changchun strain.	Harbin strain.
		Death after—			
		Hours.	*Hours.*	*Hours.*	*Hours.*
1/100 loop	Subcutaneous	44	20	46	67
1/500 loop	do	65	72	68	69
1/1,000 loop	do	65	45	55	66
1/5,000 loop	do	88	68	72	91
1/10,000 loop	do	78	92	95	91
1/100,000 loop	do	91	92	122	92
			Days.	*Days.*	
1/1,000,000 loop	do	134	7	5	89
		Days.		*Hours.*	
A small drop on conjunctiva		5	5	75	72

c. *Domestic rats*

Dose.	Inoculation.	Harbin strain.	Changchun strain I.	Changchun strain II.	Mukden strain.	Dairen strain.	Donkey strain.	Dog strain.	Bubonic strain.
		Death after—							
		Days.	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*	*Days.*
1/100 loop	Subcutaneous	2	3	3					
1/1,000 loop	do	3	4	3	3	3	3	6	
1/10,000 loop	do	5	5	5	12	12	4	6	4
1/100,000 loop	do	(a)	3	4	2	4	9	4	5
1/1,000,000 loop	do	(a)	(a)	6	13	12	4	8	4

[a] Healthy.

d. *Guinea pigs*

[Body weight, 200 to 250 grams.]

Dose.	Inoculation.	Dairen strain I.	Dairen strain II.	Changchun strain.	Harbin. strain.
		Death after—			
		Hours.	*Hours.*	*Hours.*	*Hours.*
1/1,000 loop	Subcutaneous	72	72	54	101
1/10,000 loop	do	80	74	104	97
1/100,000 loop	do	86	86	101	101
1/1,000,000 loop	do	101	101	72	88
Cutaneous		72	51	56	110

The lesions found at autopsy are similar to those usually encountered in these animals in plague infection.

e. *Dogs*

Experiments with Harbin strain:

No. 1. Intraperitoneal inoculation of 1½ loops; death after 10 days.

No. 2. Subcutaneous inoculation of 1½ loops; sick, but convalescent.

Experiments with strain from dog's lungs:

No. 1. Intraperitoneal inoculation of 1½ loops; death after 8 days.

No. 2. Subcutaneous inoculation of 1½ loops; death after 8 days.

The post-mortem lesions in the dogs that succumbed were, in general, not very marked. Their leanness alone was always most noticeable. Hæmorrhage and œdema about the point of inoculation and of the internal organs were scarcely visible. In the purulent exudate about the point of infection the bacteria were much altered morphologically, having assumed a spheroid form; they also stained poorly.

f. *Pigeons*

Intramuscular and intraperitoneal inoculation of great quantities (over 1 loop) of the plague cultures into pigeons did not produce any infection.

Feeding experiments with rats.—White rats and domestic rats were fed with mice which had died from plague infection. Death occurred after four or five days. The autopsy showed characteristic buboes of the submaxillary glands, and mesenteric buboes; also hæmorrhages and swelling of the Peyer's glands. In addition, the alterations in the lungs, spleen, liver, etc., were analogous to those seen by other methods of plague infection.

4. *Toxin production of the pneumonic plague strain*

a. *Tests with bouillon culture filtrates.*—The bouillon cultures stood for twelve days in the incubator and were then filtered through a Chamberland filter. Mice were inoculated with the filtrate as follows:

Strain.	Dose of filtrate.			
	0.5 c. c.	0.1 c. c.	0.05 c. c.	0.01 c. c.
Harbin	Death after 3 days	Healthy	Healthy	Healthy.
Changchun	Death after 24 hours.	Death after 24 hours.	Death after 24 hours.	Healthy after 2 days.
Mukden			Healthy	Healthy.
Dairen			Death after 2 days.	Death after 4 days.

The appearances of the animals at autopsy vary, according to the quantity of filtrate injected, but in general œdematous infiltration about the point of infection, swelling of the correspond-

ing inguinal glands, buboes, and hyperæmia of the spleen, liver, and lungs could be observed.

b. *Experiments with dead plague cultures.*—A two days old agar culture, grown in the incubator, was suspended in physiological salt solution and heated for thirty minutes to a temperature of 60° C. in a water bath. Mice were inoculated subcutaneously with this material as follows:

Strain.	Subcutaneous inoculation of—		
	1 loop.	1/10 loop.	1/30 loop.
Harbin	Death within 10 hours	Healthy	Healthy.
Changchun I	Death after 2 days	Death after 3 days	Death after 3 days.
Mukden	Death within 24 hours	Death after 4 days	Healthy.
Dairen I	do	Death within 24 hours	Do.
Changchun II	do	Death after 2 days	Death after 3 days.
Dog strain	do	Death within 24 hours	Death after 2 days.
Donkey strain	Death after 2 days	do	Do.

A comparison of the lesions at autopsy of these animals shows clearly that there is no connection between virulence and toxicity. I have already reported elsewhere that there is no difference between the toxicity of virulent and nonvirulent plague cultures.

5. *Tests of the resistance of pneumonic plague cultures*

a. *Resistance against some chemical agents.*—1.5 loops of an agar culture two days old was suspended in each instance in 5 cubic centimeters of the solution to be examined, a portion of which was then, after a certain period, inoculated upon agar and bouillon culture media:

Culture media.	Result with Harbin strain.	Result with Mukden strain.
0.1 per cent sublimate, 1 minute	Sterile	Sterile.
1.0 per cent carbolic acid, 10 minutes	do	Do.
1.0 per cent lysol, 10 minutes	do	Do.
Distilled water, 10 minutes	Not sterile	Not sterile.

b. *Resistance against heating in a water bath.*—0.25 loop of a two days old agar culture was suspended in 5 cubic centimeters of peptone solution, and heated to different temperatures in a water bath as follows:

Heated in water bath.	Result with Harbin strain.	Result with Mukden strain.
5 minutes at 80° C	Sterile	Sterile.
10 minutes at 60° C	do	Do.
10 minutes at 50° C	Not sterile	Not sterile.

c. *Resistance of pneumonic plague sputa to sunlight.*—(1) Smeared upon glass: (*a*) When exposed to direct sunlight, after two to five hours, sterile, the time varying according to the thickness of the layer of sputum; (*b*) when exposed to diffuse light, after eighteen to twenty-one hours, including twelve hours during the night, sterile.

(2) Smeared upon cloth. When exposed to direct sunlight, after five days, sterile. (On each day exposed for six hours.)

(3) When exposed to diffuse light in the shade, after thirteen days, sterile.

6. *Agglutination tests of plague cultures grown at the room temperature with plague immune serum*

Strain.	Dilution.				
	1:25	1:50	1:100	1:200	1:400
Harbin	++	++	+++	+++	+++
Changchun	+	+	+++	+++	++
Mukden	+	++	+++	+++	++
Dairen	+	++	+++	+++	+++
Bubonic from Manchuria	+	++	+++	+++	++
From Pasteur Institute	+	++	+++	+++	+
From Kobe	+	++	+++	+++	++
Donkey strain	+	+++	+++	+++	++
Dog strain	++	+++	+++	+++	++

The observations were made after the cultures had remained for four hours in the incubator. A clear, agglutinoid phenomenon is visible.

7. *Therapeutic injections of serum*

Three mice injected with 1/100,000 of a loop subcutaneously of the Mukden strain after three hours were again injected, respectively, with 2, 3, and 5 cubic centimeters of plague serum. All remained healthy. A "control" mouse which received 1/100,000 of a loop of culture and no serum died after three days.

8. *Prophylactic serum injections*

Three mice were injected with 2, 3, and 5 cubic centimeters of plague serum, respectively. After three hours 1/100,000 of a loop of plague culture was injected into all of the mice and into a fourth "control" animal which received no serum. The "control" died after three days; the others remained healthy.

In conclusion, I should like to add a few words about the

dispersion of the plague bacillus by coughing. It can not be denied that infection from pneumonic plague in this epidemic was conveyed almost without exception from human being to human being. It is most dangerous to be near a sick person. A few experiments were made by Dr. Tojoda and Dr. Jasuda, formerly assistants of our institute, with one patient in Mukden with regard to the ejection of the plague bacillus by coughing.

A plague patient in whose sputa plague bacilli could be found in large quantities was laid down sideways with his head fixed. Twenty agar plates were laid before his face in different positions and at different distances, and the covers were removed. After this the patient was asked to cough strongly several times. This having been done the plates were re-covered and placed for two days in the incubator at a temperature of 30° C. and afterwards examined for plague cultures. This experiment was repeated; the results were as follows:

First experiment: Plague bacilli were developed on three of the plates at distances of 1 foot, $1\frac{1}{2}$ feet, $2\frac{1}{3}$ feet, and $3\frac{2}{3}$ feet.

Second experiment: Plague bacilli colonies were developed upon four of the plates at distances of 1 foot, $1\frac{1}{2}$ feet, $2\frac{1}{3}$ feet, and $3\frac{2}{3}$ feet. The result of these experiments shows that this patient by forcible coughing could eject plague bacilli to a distance of $3\frac{2}{3}$ feet or over one yard, being dangerous, therefore, to his surroundings.

Further, these same gentlemen made an experiment in the Mukden plague hospital to ascertain whether animals which are susceptible to plague could easily be infected from the neighborhood of sick people. For this purpose they placed six guinea pigs in a wire cage, leaving it at different distances from a patient. After twelve hours the animals were removed to the laboratory and kept under observation. They all remained in perfect health. It seems, therefore, that infection of animals by inhalation is difficult. My work, of course, still shows deficiencies, as time has not permitted me to accomplish more accurate observations.

Professor GALEOTTI said that he had found this paper most interesting and most instructive. Professor Shibayama had considered almost all the points that they had before them for discussion this morning instead of only the first theme, but he thought that it would be best to discuss the different parts of the paper in the order of the programme, after the paper on each subject had been read. For instance, he thought that agglutination ought to be discussed after Dr. Martini's paper, virulence

after Dr. Strong's, etc. Unless that were done they would find themselves repeating discussions.

Dr. FARRAR supported Dr. Galeotti's suggestion.

The CHAIRMAN then called for the next paper upon

AGGLUTINATION TESTS

By Dr. MARTINI

I have only a short report to read. When Kolle and myself recommended in 1901 the agglutination of the plague bacillus as an important point in making a bacteriological diagnosis, we worked with a rather high standard serum of the Pasteur Institute. The more we heard of the diagnosis of plague cases in various large ports, the greater the value of the test appeared. I think the technique of the reaction of agglutination is well known. I might only point out now what we have already pointed out before in our publications, that the agglutination must be made in a test tube, that the effect should be observed macroscopically, and that a normal serum of the special kind of animal giving the specific serum must be used as a control. Using the method of agglutination you will have sometimes (not infrequently, in fact) an exact bacteriological diagnosis of plague earlier than you can get even a reasonable suspicion of a diagnosis from infection experiments with animals. Especially is this true in the first case or cases occurring during an epidemic. You will find in pneumonic plague that not infrequently a pure culture from the lungs or sputum may be quickly obtained for submission to the agglutination test. Therefore, we must demand the agglutination test with a specific, high-standard plague serum as an inevitable measure for making a proper bacteriological diagnosis of plague.

The next paper submitted was upon

TOXIN PRODUCTION

By Dr. GALEOTTI

Before beginning to read the short paper that I have the honor to submit to this Conference, I wish to state that, as far as I know, there have been made only the few experiments of Professor Shibayama in relation to the toxins produced by the plague microbes isolated from patients in this pneumonic epidemic. Therefore, I must confine myself to the results generally obtained with the plague bacillus. As soon as bacteriologists were able to cultivate the plague organism they tried to isolate its toxins. As regards the soluble products of the bacilli (exotoxins), it has been repeatedly stated that they possess only a

very slight poisonous property. The Indian Plague Commission found that the filtrate of liquid plague cultures has neither toxic nor immunizing effect upon animals. Dr. Wigoura, who worked with me in Bombay several years ago, established the fact that Haffkine's lymph loses every activity if it is completely freed of the bodies of the bacilli and of every quantity of microbic endotoxin which was dissolved in the liquid. More recently, at Naples, Dr. de Bonis and myself have studied the actions of filtrates of plague cultures on the circulatory and respiratory systems, and have arrived at the conclusion that the effect of these filtrates is almost nil. The constituents of the bodies of the microbes, on the contrary, are extremely toxic. The researches of Professor Lustig and myself showed that the plague toxin is a nucleoproteid not different, from a chemical point of view, from the nucleoproteids found in animal tissues. The method followed by us for the isolation of this toxin may be briefly described. When plague microbes are cultivated on large agar-agar plates they form a thin layer. This growth is scraped off from the surface of the solid culture medium, and treated with caustic potash. By the strong alkali the microbes are not only killed, but are also disintegrated and dissolved. To the resulting solution acetic or hydrochloric acid is added until a white, flocculent precipitate is thrown down. This precipitate consists chiefly of the nucleoproteid, and can be dissolved in a solution of carbonate of soda. By successive precipitations with acid and redissolving with alkali, the nucleoproteid can be purified until it shows a constant chemical constitution. I have performed the elementary analysis of such a substance and found that it contained about 12 per cent of nitrogen and 0.03 to 0.04 per cent of phosphorus. This nucleoproteid gives all the reactions of a proteid substance, and if dissociated by a strong acid it gives origin to purin bodies and peptones, which no longer possess toxic properties.

The activity of the toxin has been thoroughly studied upon different animals, especially on monkeys, rats, rabbits, and dogs. If a large quantity be injected into the vein of a dog the animal dies very quickly in consequence of the intravascular coagulation of the blood. At the section, thrombi and infarcts are found in the heart, in the big vessels, and in the lungs. As regards the circulatory system, I have demonstrated that the plague toxin produces dilatation of the arteries, lowering of the blood pressure, and different alterations of the heart muscle, both functional and structural. These last experiments were done on the isolated rabbit heart. The action of the plague nucleoproteid on the respiratory system has also been investigated by us. This question is of distinct importance now, because it is connected with

the alterations in the lungs in the pneumonic form of plague. The experiments which were performed recently in the Institute for Experimental Pathology in Naples consisted in taking tracings of the respiratory movements of rabbits in which a convenient quantity of toxin had been injected. Afterwards, the microscopical alterations in the lungs were studied and described. It would be very important to compare the respiratory disturbances and alterations found in these animals with those which have been found in the lungs of plague patients during this epidemic. The plague nucleoproteid also produces fever and considerable disturbances of the general metabolism, as is demonstrated by the malnutrition, by cachexia, and by the increased nitrogen and phosphorous elimination in the inoculated animals when they do not die too soon after the treatment.

When brought into immediate contact with the cells of different organs and tissues the toxin causes marked changes, which have been minutely described. Generally, necrotic and degenerative alterations appear in the parenchymatous cells, but on the contrary there is a stimulation of the cells of mesoblastic origin (especially of the leucocytes) which show an anomalous activity of motility and reproduction. It is for this reason that the lymphatic organs in contact with the plague toxin become swollen and contain so large a number of lymphatic and myeloid elements, and that the inflammatory exudates produced by this toxin are so extraordinarily rich in morphological elements. In this regard I can add that the plague nucleoproteid possesses a strong, positive, chemotactic activity.

In conclusion, I wish to state that all the symptoms and phenomena observed in plague patients and on experimentally infected animals can be produced with the pure toxin, which can be easily isolated from the bodies of the plague bacilli.

DISCUSSION ON AGGLUTINATION

Dr. STRONG. I should like to return to the subject of agglutination for a moment and to ask Dr. Martini whether, with strains isolated during this epidemic, he has found that the mucus-like production of the organism has actually rendered the making of suspensions of the organism for agglutination tests more difficult than in the case of bubonic strains. One of the particular difficulties in performing the agglutination tests with the pest bacillus is the obtaining of proper suspensions of the organisms in which the organisms do not become precipitated spontaneously. Unsatisfactory suspensions frequently lead to errors, pseudo-agglutination frequently resulting.

Dr. MARTINI. If you cultivate the bacillus at a certain temperature, from 30° to 35° C., there is a great deal of mucus production, and it is very difficult to agglutinate it. If you cultivate it at a temperature between 20° and 25° or 25° and 28° C., you get proper agglutination.

Dr. STRONG. I am aware of the experiments relating to the performance of the agglutination test with cultures grown at different temperatures which have been previously published, but I refer to the mucus production of cultures isolated in this epidemic. Professor Shibayama spoke of the distinctly greater mucus-like production of the cultures isolated in this epidemic as compared with that of bubonic strains. I want to ask whether greater difficulty was observed in making suspensions with these organisms than in the case of bubonic strains.

Professor SHIBAYAMA said that there was distinctly more mucus and greater difficulty in preparing suspensions with the pneumonic strains.

Dr. FARRAR stated that it was the feeling of a great many of the Delegates that it would be much easier for those responsible for compiling the reports and would lead to clearer results if the meeting adhered to the programme, and discussed each paper as it was read. The discussion of Dr. Martini's paper had been omitted.

Dr. WU said that he fully agreed with this view.

Dr. FARRAR then proposed and Dr. WU seconded the proposal "that we follow the programme strictly and discuss, in accordance with the programme, each point, point by point, as it is introduced."

The CHAIRMAN ruled that the meeting had already expressed its preference to adopt the other course and to discuss all the papers in this section together, owing to the fact that some of the speakers had not confined themselves to the topics assigned.

Dr. Strong was then called upon to speak upon the next subject:

VIRULENCE

By Dr. STRONG

I agree with Professor Zabolotny and Professor Shibayama that during the present epidemic of pneumonic plague the organism giving rise to the disease has possessed a very high degree of virulence.

From inoculation experiments in animals, however, this virulence has not shown itself to be any greater than that exhibited by certain strains of plague bacilli isolated from bubonic plague cases, guinea pigs dying usually in from three to six days after

cutaneous infection, and mice in a slightly shorter time from subcutaneous injection of amounts as large as one-fourth *oese* of an agar culture. The excessive virulence of the organism in the present epidemic, therefore, seems to be more apparent than real. I say "seems to be," for I must preface these remarks with the statement that in my opinion this question will require further study, for we have not yet examined the virulence of many of the strains isolated from pneumonic cases. It is my intention in the future to test in each instance the virulence of these numerous cultures (more than fifty in number) which we have isolated during the present epidemic. With the strains already studied, however, the virulence has not been greater than in the case of certain bubonic strains.

The question, therefore, at once arises if the organism in the human body during the present epidemic has not been of a very much greater virulence than that seen in some bubonic plague cases, how can we explain the excessive rate of mortality and the great acuteness of the cases of the disease which almost invariably speedily terminate in death? The first explanation which seems most probable is that the channel of infection is different in pneumonic and bubonic plague, and that the plague organism finds in the pulmonary tissues a much more favorable and extensive medium for its growth and much less resistance to its ability to multiply than it does in the lymphatic glands. In bubonic plague the lymphatic glands act as filters against the general invasion of the organism with the plague bacillus, while in epidemic pneumonic plague there is no such resistance, the bacilli spreading rapidly throughout the lung and invading the circulation in almost every instance. The bronchial glands offer resistance to the bacilli, it is true, and in all cases of pneumonic plague are very acutely inflamed and almost black in color from resulting hæmorrhages in the gland substance. However, by the time the bronchial glands become involved, the organisms have already spread themselves so extensively through the lung substance that a bacteræmia has either already occurred or is imminent. Anyone who has examined microscopical preparations from the lung in the present epidemic can not fail to be struck by the enormous number of plague bacilli which are invariably present. In primary pneumonic plague the organisms were found in very much greater number in the tissues of the lung than in those of the spleen, a point which would suggest the lung as a more favorable organ for multiplication of this organism. The bacteria are usually present in far greater number in the lung than one ever finds them in the buboes or spleen in bubonic cases. The lung, which in pneumonic plague may be

said to represent the primary bubo, contains by reason of the size of the infected area a far greater number of plague bacilli than the primary bubo in bubonic plague. Also, the fact that in epidemics of bubonic plague occasionally small epidemics of pneumonic plague occur in which the same high mortality and very acute course of the disease is observed argues that in epidemics of bubonic plague the causative organism may show the same high virulence. Such an occurrence was witnessed in the epidemic of bubonic plague in Japan, in the cities of Kobe and Osaka in 1899 and 1900 (reported by Kitasato and his assistants), where thirteen cases of primary pest pneumonia all terminated fatally after a very rapid course. For these reasons I do not think we can say, without further proof from additional experiments, that the organism during the present epidemic is of a very much greater virulence than that isolated from some bubonic plague cases. Rather it would appear that the acuteness of the course of infection and the very high rate of mortality is due to the portal of entry of the organism and the locality of the primary infection.

During the present epidemic a marked stability of virulence of the plague organism has been observed, and almost at the close of the epidemic in Mukden the organism was found by inoculation into animals to be fully virulent, and to kill as quickly and in the same doses as one of the strains isolated from a pneumonic case nearly a month before. In this connection the classical experiments of Martini are very interesting, and reasoning from them it would be surprising if any marked loss in virulence of the organism toward the close of this epidemic had occurred, since in the present one the infection has resulted directly from man to man, frequently from lung to lung, one might almost say, and without the intervention of the passage of the organism through rodents. For these reasons, and from the experimental proof furnished by the inoculation of animals that the organism was fully as virulent at the close of the epidemic, it would be wrong to conclude that the sudden cessation of the epidemic was due to any marked change in the virulence of the plague bacillus. Such a cessation must have depended upon other causes. I have pointed out elsewhere, at some length, that the plague organism is frequently one of very stable virulence, and that, while it is not a very resistant organism in nature and readily becomes destroyed under certain conditions, it frequently does not become attenuated easily either in passage through the animal body or outside of it. This quality of the plague bacillus is particularly interesting from an epidemiological standpoint.

It has been suggested by some of the Delegates that toward the

close of the epidemic involution forms of the bacillus were often observed in the sputum and blood of the cases infected and that this was an evidence of a loss of general virulence of the organism. Poorly staining and swollen degenerated forms of the plague bacillus are frequently found in cases of most acute and virulent infection and are the result of the struggle between the serum of the host and the invading organism; they depend upon the relationship between infection and immunity of the host. In every infection a number of bacteria always become degenerated, show plasmolysis, or are killed in the attempt of the serum and cells of the host to overcome the infection. The presence of these degenerated forms may have no significance in regard to the virulence of the infecting organism as may be proved by inoculation experiments performed with it.

In conclusion, I wish to say that it will take several months to complete our bacteriological work upon the cultures we have isolated during this epidemic.

Dr. MARTINI then proposed, Dr. ASPLAND seconded, and it was carried *nem. con.* that the discussion of the morning's papers be postponed until the beginning of the next session upon bacteriology, in order to enable the Conference to attend the exhibition of medical objects referring to plague at the South Manchuria Railway Company's Hospital at 2 p. m.

SESSION IV, APRIL 7

PROGRAMME ARRANGED FOR THE DAY

A. EPIDEMIOLOGY.

3. The relation of animal plague to the past epidemic.
   b. Rats.
   c. Other animals (pigs, dogs, horses, etc.).
4. The character of the past epidemic curves as illustrated in cities and districts.
5. The relation of the past epidemic to climatic influences, atmospheric temperature, and humidity.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Relation of rat infection; discussion.
3. Discussion on infection in pigs, dogs, and donkeys.
4. The effect of temperature upon the mortality curves.
5. Relation of mortality to meteorological conditions.

PRELIMINARY BUSINESS

The meeting came to order at 10 a. m., Dr. WU in the chair.

The SECRETARY read the following telegram:

"The Bacteriological Society of Tokyo has the honor to send hearty greetings to all the Delegates, and wishes them every success and good results from the Conference."

Dr. GRAY. I desire to take up a moment of the Conference's time in regard to sending a telegram to the Union Medical College of Peking. I ask this for a special reason. This is the first occasion upon which this college has had graduating ceremonies. After five years' work it is turning out its first graduates in scientific medicine. During the Conference this college has given us a great deal of assistance. Eight of its foreign doctors, twelve graduates, and twelve senior students have assisted in the plague work, of whom two lost their lives. I propose that the following telegram shall be sent forthwith:

"The International Plague Conference unites in congratulating the Union Medical College on the graduation of its first class of students to-day. They welcome the graduates to the membership of the medical profession, and send them their best wishes for a successful career."

This proposal was carried unanimously. The minutes of the previous session were confirmed.

The CHAIRMAN. The next matter is the question of the appointment of

an editorial committee. I believe that it is the wish of the Conference that the editing of the reports should be placed in the hands of a special committee. Four Delegates have been nominated, and their names have been presented to me. The first name is that of Dr. Strong, whom we all know. Dr. Strong has been an editor of the medical section of the Philippine Journal of Science for several years. The next is Dr. Martini, who needs no commendation from me, and the other names are those of Dr. Petrie, who had a great deal to do with the reports of the Indian Plague Commission, and lastly of Dr. Stanley, who is at the head of the Shanghai Municipal Health Office, and whose reports we have always read with interest.

These nominations were unanimously confirmed.

Dr. PETRIE. I beg to propose a cordial vote of thanks to the directors of the South Manchuria Railway for so kindly sending us their views and pamphlets relating to work upon the railway. I think we have all found them extremely interesting.

This proposal was seconded by Dr. STRONG and carried unanimously.

Dr. FARRAR. I beg to propose that in order to complete the discussion on A 1–5 of the Bacteriological Programme, there shall be a special session of the Conference this (Friday) afternoon at 2 p. m.

This was seconded by Professor GALEOTTI and carried *nem. con.*

Dr. PETRIE. I beg to propose that with a view to facilitate the work of the Conference all the reports and papers arranged for each day by the programme committee shall be read without discussion, in accordance with rules of procedure 5 and 6, and that thereafter the Chairman shall invite discussion separately on each successive point specified in the official programme of the day's work.

I believe that this resolution expresses the general feeling of the Delegates. I should only like to say that it would help to condense the discussions and also would prevent omission of any important points that may arise during discussions. The only difficulty involved is that there might be a number of papers read one after the other, resulting in the possibility of points of inquiry being omitted. That, I think, could easily be met by noting down at the time points upon which information is required.

Dr. MARTINI seconded this resolution, which was then carried unanimously.

Professor KITASATO then took the chair, and called upon Dr. Koulecha to read his paper upon *Morbid anatomy, especially in relation to the mode of infection in plague pneumonia.* (See Session IX, p. 151.)

At the close of this paper and its discussion Dr. ASPLAND moved and Dr. FARRAR seconded a proposal that the paper of Dr. Koulecha and the subsequent discussion upon it should not be included in the minutes of this session but should take its place in correct order in the discussion with which it was connected. (In this connection see also resolution, p. 40.) This proposal was carried, and Professor Kitasato then vacated the chair in favor of Dr. Wu.

The CHAIRMAN. We now return to the section of epidemiology, *The relation of animal plague to the epidemic.* I understand Dr. Andrew has some evidence to place before the meeting on this subject.

RAT INFECTION

By Dr. ANDREW

I have only one or two observations that I desire to put before you in regard to the rat population of north China, and some observations upon the fleas of north China. I wish to put these facts before the Conference especially in regard to a possible outbreak of bubonic plague now or later on. The work I am about to describe was carried out at Tongshan after the last outbreak of bubonic plague there in 1908. That was the last outbreak of plague in north China previous to the recent epidemic. My investigations were carried out from June, 1909, to September, 1910. During that time I examined about 3,000 living rats. They were all caught in Tongshan village. Cage traps were sent out all over the town, and accompanying each of them was a black cloth bag. When a rat was caught the trap was placed in the bag and brought to the laboratory. I did this in order to capture as many fleas as possible, because I knew that it had been found in India that the fleas had a tendency to leave the rats if exposed to sunlight. In the laboratory the trap was removed from the bag and the rats chloroformed. A careful count was then made of the fleas. This was done in about three thousand cases. First, as regards the rats themselves, it may be interesting to state that I found only *Mus decumanus; Mus rattus* was never found. I made counts of the fleas upon each rat from June, 1909, to September, 1910. I have expressed the results obtained in a curve which shows the average number of fleas per rat for each month. One point illustrated by this curve which I wish specially to emphasize is that in Tongshan there is a seasonal prevalence of the rat flea. The highest number of fleas occurs in the autumn months of September, October, and November, or August, September, and October. I examined many thousands of fleas, but the only species noted was *Xenopsylla cheopis.* During the autumn seasons of 1909 and 1910 the fleas were six to eight times more numerous than in the winter, spring, or summer months. The Tongshan epidemic occurred at the beginning of September, when this wave of *Xenopsylla cheopis* would be at its height. Before there can be an outbreak of bubonic plague three factors must be present. There must be a source of infection, there must be a sufficient number of susceptible rats, and there must be a sufficient number of rat fleas. As I said before, this Tongshan epidemic occurred in September, when the wave of fleas was at its height, so that I can offer the opinion that for the next few months to come

there is not much chance of an outbreak of bubonic plague in north China. The facts, to my mind, point to an epidemic taking place some time in the autumn, if at all.

Chart showing average number of fleas per rat for the months June to December, 1909, and from January to September, 1910

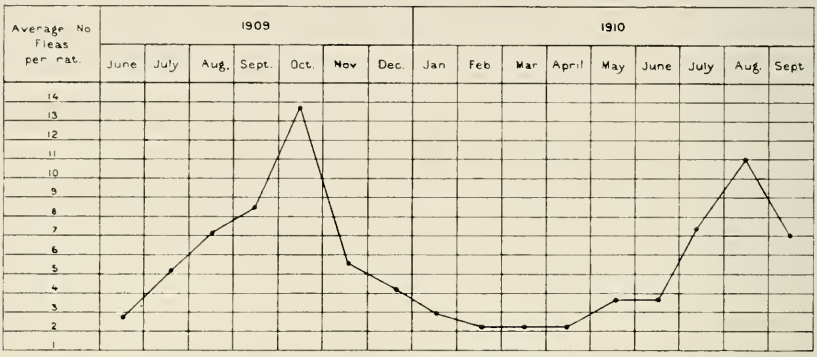

PLATE XVIII. CURVE SHOWING THE SEASONAL PREVALENCE OF THE RAT FLEA.

From the curve I have prepared, we must look upon the present time as the off season as far as bubonic plague is concerned. My observations may be summed up as follows: That the *Mus decumanus* was the only species of rat noted, and that there was a marked seasonal prevalence of *Xenopsylla cheopis* in the autumn months.

DISCUSSION

Dr. PETRIE asked if the climatic conditions in Tongshan were similar to those in Manchuria. If so, he thought that the results of Dr. Andrew's investigations could be applied in estimating the probability of an outbreak of rat infection in Manchuria. Dr. Andrew had stated that *Mus decumanus* was the only species that he had found. He (Dr. Petrie) had examined only a few hundred rats in Mukden, and they were all *decumanus*. The fleas he had examined seemed to belong to two species, *Xenopsylla cheopis* and *Ceratophyllus sp.* *Xenopsylla cheopis* was found especially in tropical regions, while *Ceratophyllus sp.* was the commoner species in countries with a temperate climate. It would, therefore, be interesting to work out flea-prevalence curves for each species of flea in this part of China.

Dr. ANDREW said that there was not very much difference between this part of China and Tongshan so far as climate was concerned. Both places had a very cold winter and a hot summer.

Dr. FARRAR said that it would be interesting to know whether it had been established that no infected rats had been found in Manchuria. Dr. Haffkine was present, and perhaps he could make some observations upon this point.

Dr. HAFFKINE stated that in the case of the rat he believed to be infected at Harbin the diagnosis had not been confirmed by bacteriological examination.

Dr. PADLEVSKY. In Harbin we found one plague-infected rat in a house where people had been stricken with plague. The diagnosis of plague was confirmed by cultures, by animal infection, and by agglutination tests.

Dr. PETRIE asked whether the post-mortem appearances of this rat indicated cutaneous or intestinal infection.

Dr. PADLEVSKY replied that it showed a pneumonic infection.

Professor KITASATO said that he had investigated the question of fleas in Mukden and had found that out of 127 rat fleas 48 were *Xenopsylla cheopis* and 79 *Ceratophyllus anisus.*

Dr. STANLEY stated that in regard to the question of species of rats and fleas he would like to put on record the observations made in Shanghai. There they had found *Mus rattus* and *Mus decumanus.* Seventy per cent of the rats were *Mus rattus.* As regards fleas, they had found both *Xenopsylla cheopis* and *Ceratophyllus* sp.

The CHAIRMAN observed that, with the exception of the case mentioned by Dr. Padlevsky, no case of rat infection had been mentioned.

Dr. STRONG asked how many rats were examined at Harbin.

Dr. FANG said that 72 had been examined in Fuchiatien, and Dr. Haffkine stated that 30 had been examined at Harbin.

Professor KITASATO said that the Japanese authorities had examined over 30,000 rats in South Manchuria, and had not found a plague-infected rat among them.

Dr. PETRIE asked the last speaker what species of rats had been found in South Manchuria.

Dr. STRONG asked how many of these rats had been examined during the current year.

Professor KITASATO replied that 6 per cent of the rats examined were *Mus rattus,* and that all rats had been examined during the present year.

Professor ZABOLOTNY stated that the laboratory staff of the Russian expedition had examined only 67 rats, but a complete examination had been made in every case.

DISCUSSION ON INFECTION OF PIGS, DOGS, HORSES, ETC.

The CHAIRMAN said that with the permission of the meeting he would close the discussion on this subject and proceed to the next question, namely, *The occurrence of plague in other animals—pigs, dogs, and horses.*

Dr. STRONG said that pigs were known to be relatively insusceptible to plague infection, and unless someone had any evidence to show to the contrary and that these animals had been infected during the recent epidemic, he thought this subject might be passed over.

Dr. FARRAR suggested that if that were so it should be definitely placed upon the record in view of the fact that it had been so widely stated that pigs were liable to infection. Although this was a scientific congress he thought that that fact should be definitely stated for the sake of reassuring the public in Europe and China.

Dr. STRONG said that he had merely suggested that they should pass over the question of infection in pigs, as no one seemed to have any definite information to offer that they had been infected. If there was any evidence on this question he hoped it would be presented.

Dr. WU said that while he was in Harbin there was a well-known rumor that over 300 pigs and 400 horses and mules had died. It was, therefore, interesting to be able to inspect the preparations of the plague-infected donkey in the Japanese exhibits. These specimens lent support to the contention of the Chinese doctors that they had observed the spitting of blood by horses and mules in Harbin.[1] Of course, these animals might have died from some disease other than the plague, but the fact that they died in such large numbers during this epidemic was significant. In regard to pigs, they knew that Simpson had experimented upon a large number of animals, and, although they knew his experiments had not been confirmed, the question of infection in pigs would be a very interesting one for investigation.

Dr. GRAY. Are there any observations with regard to dogs eating plague corpses?

Dr. FUJINAMI said that he knew of only three cases of animal plague during the recent epidemic, two of donkeys and one of a dog. The first case of a donkey happened at Fushun. When the

[1] Subsequent experiments performed by Dr. Teague and the writer in the Biological Laboratory, Bureau of Science, Manila, have shown that donkeys are not susceptible to pneumonic-plague infection, but that dogs are. Article in press, *Phil. Journ. Sci.*—[EDITOR.]

donkey became sick it was taken into the open, where it died. Dr. Otsuki had made a post-mortem examination and found pathological and bacteriological proof of plague infection. The second donkey contracted plague from contact with the first. This donkey also died of plague, and the fact was established by pathological and bacteriological examination. The third case was that of a dog in Changchun, in a house in which seven persons died from plague. This dog was examined in the same manner as the donkeys. It was known that dogs and donkeys were not generally susceptible, but the question was still an open one, and he could not make any further observations about it for the present.

Dr. CHRISTIE said that he had received a report of a case in a village between Mukden and Hsinminfu, where there had been no plague previously. In this case the donkey was taken into a room, fifty feet long, in an inn, a common custom in villages in those parts. A man in this inn died from plague, and two days later the donkey began to cough and blood came from its nose. The people became alarmed and wanted to kill it. A man was present from another village when the matter was being discussed, and he wished to take the donkey away. He took hold of the bridle, and in doing so his hand became smeared with blood from the donkey's nose. He did not take the donkey away, but returned to his own village and three days later he died, being the first in that village to succumb to plague. The man who eventually killed the donkey also died from plague, but it was not established whether he caught it from the donkey. Further north there was a case of a donkey which died outside a gate. The people were not familiar with the disease and in some manner handled the donkey. Three days later the compound in which these people lived became infected.

Dr. PETRIE asked from what source this information came.

Dr. CHRISTIE said that he obtained the history of this case from a Dr. Young, who obtained the information indirectly from a Japanese doctor.

Professor KITASATO asked Dr. Christie if these cases had been properly examined.

Dr. CHRISTIE. No.

Professor KITASATO. Then you can not be sure that they were plague.

There being no further discussion on this subject, the Conference then proceeded to the section upon *The character of epidemic curves as illustrated in cities and districts.*

The following paper was then read:

EFFECT OF TEMPERATURE UPON THE MORTALITY CURVES DURING THE EPIDEMIC

By Dr. Hill

I have tried to find out in two ways whether the weather in any way affected the death rate, namely, by inquiry in eighteen different centers and by the study of charts showing the daily death rate and temperature. Inquiry led to no definite results, but some doctors replied that fine weather favored the dissemination of the disease and that a fall of snow checked it. One doctor sent me a chart designed to show that a rise of the minimum temperature above zero (Fahrenheit) was followed by a fall in the death rate, but I doubt if the chart supports his conclusions.

Examination of charts has thrown a little light on the subject, but unfortunately I was able to get only two sets of thermometric records. However, a chart obtained from Kirin [1] shows fairly well the chief points, and that of Mukden agrees with it. Instead of the daily death returns I have taken the average of two successive days' death returns to represent the number of persons infected seven days before. This is indicated in red. The black curve represents the number of degrees below freezing. A high black line indicates great cold. The black line marks the temperature of the day seven days earlier than the red line in the same column—i. e., the temperature on the day when the patients marked in that column were infected, not when they died. The first point of interest is that sometimes the black and red curves move together, sometimes in opposite directions, but when the black is very high or very low the red moves in the opposite direction. In other words, temperature seems to have but little effect, except that an unusually mild day is followed a week later by a high death rate, a very cold day tends to lower the death rate. Both charts show this at times. I refer only to variations within the limits of winter temperature, not to seasonal variations.

The chart shows that the natural movement of the death rate is in waves, the period of which is about five days, corresponding to the incubation period. This is what one would expect, and must be allowed for before concluding that other factors have influenced it. It diminishes the significance of the coincident mildness and high death rate seen in the charts.

[1] These charts were not submitted for publication; their significance is explained in the text. For the death rate in relation to temperature in Fuchiatien and in Mukden, see Plates X and XI.—[Editor.]

This wave movement is plainly visible in these other two charts of death rates (made as before by taking two successive days together). One is of Mukden, the other of Changchun.

The Mukden chart shows clearly three waves of the same shape in successive five-day periods. This is then interrupted. Apparently another wave is superimposed and the first is blotted out, and a steep rise preceded by a notch appears which remains to the end of the chart; rising and falling, the notch and dicrotic wave on the falling limb are preserved. In the last two periods the wave length becomes six days, corresponding to a lengthened incubation period noticed during a certain phase of the epidemic.

In the Changchun chart the wave movement is equally well marked. It is noticeable how the minima occur punctually on the fifth day almost throughout.

There is one other point worth mentioning; that is, the close resemblance between these three charts. Those of Kirin and Changchun are especially alike, though Kirin's waves are one day behind Changchun's and Kirin has a second outbreak which Changchun escaped. They are about 200 li [66 miles] apart.

The likeness of the Mukden to the Kirin chart is also very striking. Kirin was infected about a fortnight later than Mukden. I can offer no opinion as to whether the similarity has any definite significance. If it has, it must be due to some influence acting over large areas and perhaps traveling slowly from place to place, possibly, therefore, some climatic factor, but probably not simply cold. Against this is the factor that the decline comes early in the Kirin epidemic. If this meant efficient quarantine there would probably not have been a second rise to a maximum. Mukden's decline is very late, but there is no recrudescence.

CONCLUSIONS

1. Charts, made by taking the average death rate for two successive days together, show a regular wave motion whose wave length corresponds to the incubation period of pneumonic plague.

2. Allowing for this, the apparent evidence of influence of temperature on death rate must be largely discounted. Probably only extremes of temperature had much effect. Seasonal variations are not contemplated in this paper.

3. Nevertheless, the similarity of the charts suggests the probability of some factor, possibly climatic, at work perhaps traveling slowly from place to place, though it may be only the gradual improvement of quarantine work that produces the effect.

Dr. HAFFKINE, who was to have read a paper upon the next item on the programme, *The relation of the epidemic to climatic influences, atmospheric temperature, and humidity,* said that he had been unable as yet to prepare it, and asked to be excused until a later session.

RELATION OF MORTALITY TO METEOROLOGICAL CONDITIONS

Professor GALEOTTI then showed diagrams relating to the mortality at Bombay in 1897 and 1898, and comparing the mortality with the meteorological conditions. He pointed out that the mortality curves were very similar to those that had been presented by Dr. Haffkine of Fuchiatien. [See Plate X.] When the temperature fell the mortality increased, and when the temperature rose the mortality diminished. The similarity in these charts of epidemics of such different characters was most remarkable. He produced another diagram showing the mortality and the temperature of Bombay during the winters of 1896 and 1897. In every one a similar curve could be observed.

Dr. FARRAR said that the programme committee wished to ask the desire of the Conference with regard to procedure before the session was adjourned. Professor Kitasato and other Delegates, he understood, had expressed the wish that the whole of the bacteriological section should first be disposed of and that the Conference should then return to the epidemiological portion of the programme. As he understood this to be the general wish, he proposed that the Conference should go on with the bacteriological portion of the programme before proceeding with the epidemiological and administrative portion.

Professor KITASATO seconded this proposal, which was carried, and the Conference then adjourned.

SESSION V, APRIL 7, 2 P. M.

SPECIAL SESSION FOR THE PURPOSE OF DISCUSSING SUBSECTION 1 OF THE BACTERIOLOGICAL AND PATHOLOGICAL SECTION

PROGRAMME ARRANGED FOR THE DAY

C. Bacteriology and Pathology.
1. Characters of the strain of bacillus isolated during the epidemic.
a. Cultural tests.
b. Agglutination tests.
c. Toxins.
d. Virulence.
e. Pathogenicity to animals.

Professor Kitasato took the chair at 2.10 p. m.

The first topic for discussion was

CULTURAL TESTS

Professor Zabolotny stated that the differences in the cultures in bouillon between the pneumonic and bubonic strains had been referred to. He had examined some old cultures from Mongolia and had found that the bouillon became turbid as the bacilli were growing. Professor Shibayama had stated that the pneumonic and bubonic strains of bacilli grew usually quite equally, but added that he had noticed a little difference in the growth in bouillon and that there was more mucus production in the pneumonic plague cultures and some slight difference in the growth of the bacilli.

Professor Shibayama said that after thinking it over he had come to the conclusion that this difference was so slight that it could not be taken as the main point. It might depend upon the mode of infection of the bouillon. If he took a small portion of the agar culture and rubbed it on the glass and allowed it to stream slowly into the bouillon, the latter got turbid, but if it were allowed to fall straight into the bouillon, and was then shaken, the bouillon became floccular. The same thing happened with cultures of streptococci.

Professor Galeotti said that the presence of more or less

mucus in the culture depended upon the amount of carbohydrates in the bouillon. The same kind of bacilli produced a larger or smaller quantity of mucilaginous substance, according to the quantity of the carbohydrates present.

Professor ZABOLOTNY stated that he had developed his cultures in the same bouillon and with the same methods of infection.

Professor SHIBAYAMA stated that he had also used the same bouillon in his experiments.

Professor ZABOLOTNY expressed the opinion that this characteristic feature, the turbidity of the culture, was a special property given by certain strains of streptococci, and that the turbidity did not depend upon differences in the bouillon.

Dr. PETRIE suggested that it would be interesting to know whether any observations had been made with regard to the stalactite formation; whether good stalactites were formed or not. In some of the strains tested in Bombay the nonvirulent strains produced poor stalactites, while the more virulent strains produced good stalactites.

Dr. MARTINI said that he had observed very good stalactites with the Shantung strain.

Dr. ANDREW said that he had an opportunity since the beginning of February of watching a very large number of flasks of vaccine made with the Harbin strain, and several times he had seen typical stalactites.

Professor ZABOLOTNY stated that he had made the following observation when he inoculated bouillon from agar. He could see threads of mucus if he scraped the surface of the growth on agar. These pneumonic cultures had a great deal of mucus.

Professor SHIBAYAMA stated that in his opinion the amount of mucus depended somewhat upon whether the culture medium was more or less alkaline. The more alkaline it was the less mucus there was produced.

Dr. PETRIE said he would be glad to know whether any cultural tests had been made with this strain of bacillus in carbohydrate media, such as dextrose, lactose, mannite, or maltose, and whether the reactions had been compared with such cultures of bubonic strains. He believed that Dr. Zlatogoroff had previously made some experiments on this point.

Professor ZABOLOTNY replied that he could not say anything in regard to that point. [Dr. Zlatogoroff was absent.]

Dr. PETRIE said that in looking over some preparations of smears from glands, sputum, and blood, he had formed the impression that some of the bacilli were unusually large and long as compared with the bacilli from other sources; e. g., from rat plague organs and from septicæmic cases in India.

Dr. MARTINI said that he had found some very large and long bacilli and some very small ones mixed with them. He could not see any definite difference.

Dr. WU said that in some of the specimens from blood he must confess that the bacilli looked unlike those found in the sputum, and in a good many cases the specimens looked like diplococci.

Dr. STRONG stated that he had had an opportunity of examining preparations from a very large number of cases, but he could not see any difference in morphology between the pneumonic and bubonic strains. Pleomorphism was a very well-known feature of the plague bacillus.

AGGLUTINATION

Professor ZABOLOTNY said that the agglutination test was necessary to complete the diagnosis of the bacillus of plague. He demanded a high standard serum with a high agglutinative power. This was necessary for correct diagnosis. Personally, he did not attempt to use the serum of patients, but took the serum of horses immunized with many cultures, and thus obtained a serum of high agglutinative degree.

Dr. STRONG asked if anyone had found plague agglutinins clinically in the blood-serum of any of the pneumonic cases during the epidemic.

Professor SHIBAYAMA said that there had been three cases in Dairen. They had received 40 cubic centimeters of plague serum and recovered, and agglutination tests were made forty-five days afterwards. The blood then showed positive agglutination in dilutions of 1 to 50 and 1 to 100. Plague serum injected into patients gives their serum an agglutinating power, but after thirty days it was not possible that there could be any agglutinating reaction from the serum injected.

Dr. FARRAR suggested that experiments should be made during the Conference. Probably most of those present had been inoculated recently with various vaccines or sera, and it would be interesting to make experiments by testing their blood. Professor Galeotti might be prevailed upon to make these tests.

Dr. STRONG said that he was very sorry, but he must beg to differ from Dr. Farrar. He thought that such an investigation would be tedious and that little would be accomplished. He had frequently sought for agglutinins in patients and animals inoculated with small doses of plague vaccines and sera. In order to find demonstrable agglutinins in the blood-serum it was necessary to inoculate animals with frequent large doses of plague bacilli.

Dr. MARTINI stated that he fully agreed with Dr. Strong.

They knew that frequent injections of big masses of bacteria were necessary to get a high power of agglutination of the serum. With regard to what had been said by Professor Shibayama, relating to the persons who had recovered, so far as he could remember he had never heard of such a high power of agglutination in plague. Generally 1 to 10 or 1 to 5 was what he had heard of.

Professor ZABOLOTNY said that he had examined patients in India during their convalescence, and an agglutinating power of 1 to 15 was usually the highest he had found in such cases. He had examined the blood of plague pneumonia patients in the first days of the disease, and had found no agglutinating power in the serum. During the first week in bubonic plague there was very little agglutinating power, but after the first week he had found it. He had found a very high standard of agglutinating power in the serum of animals treated with repeated masses of bacilli. He had a serum which agglutinated an old culture strain in a dilution of 1 to 1,000 and cultures of the present plague pneumonic strain in dilutions of 1 to 300 or 1 to 500. The fresh cultures were not so agglutinative.

Dr. MARTINI said that Professor Shibayama had stated that the reason for this was that the pneumonic strain produced more mucus.

Dr. HEHEWERTH asked whether any comparison had been made between strains of former epidemics and of the recent epidemic.

Professor SHIBAYAMA said that comparisons had been made.

Professor ZABOLOTNY stated that he had made comparisons with strains from Bombay, Odessa, and other places, and with rat strains. He had made cultures over a period of twelve years.

TOXINS

Dr. STRONG agreed with Professor Galeotti in so far that the pest toxin is an endotoxin and not a soluble one, and that it is contained in the bodies of the bacteria and becomes set free in bouillon cultures by plasmolysis and plasmoptysis.

Dr. MARTINI said that he agreed that it was an endotoxin.

Professor ZABOLOTNY did not believe that it was an endotoxin but a toxin, produced in a way similar to that of the diphtheria bacillus, but different from that of the cholera and typhoid bacillus. In the case of the bacilli of typhoid fever and of cholera only a small amount of toxin was produced by the bacilli, but in the case of the plague bacillus a greater amount of toxin was produced. He was more in accordance with the views of Markl.

Professor GALEOTTI said that there was no evidence that sol-

uble toxins were formed by the plague organism. Experiments performed with the endotoxins had produced all the symptoms of plague, and therefore he did not admit that soluble toxins were formed in the organs of plague-infected patients.

Dr. STRONG asked Professor Zabolotny whether he could give any experimental evidence of the production of a soluble toxin by the plague bacillus.

Professor ZABOLOTNY said that if he filtered five or seven days old cultures, he found toxins in the filtrate which would kill monkeys, and therefore he believed that the toxins were produced by the bacilli and did not come from the dead bacilli. An antiserum made by the bacilli was antitoxic against these toxins.

Dr. STRONG said that he did not think they could conclude definitely that the pest organism produced soluble toxins from the experiments with five or seven days' bouillon cultures alone. In such cultures, if one investigated the condition of the organisms, one would always find that many of the bacilli had already undergone plasmoptysis or plasmolysis, and had become degenerated and broken up. Endotoxins must then be set free. In the older bouillon cultures there was more endotoxin than in the younger ones. One saw very much the same phenomena in cholera. He did not think that there was any clear evidence yet that the pest bacillus produced soluble toxins. He regretted that there was no new evidence on this subject forthcoming at the Conference.

Professor GALEOTTI said that it was quite certain that in the filtrate of the culture there was a certain quantity of endotoxin. If this filtrate were treated with an acid all the endotoxin was precipitated, and then the filtrate became innocuous. He, therefore, considered that there was no proof that the plague organism produced a soluble toxin.

Considerable informal discussion ensued between Professors Shibayama and Zabolotny upon this point.

Professor KITASATO intervened to say that he thought this was a question for specialists which could not be settled at this session. It was entirely a matter for study in the laboratory, and, perhaps, it would be best to appoint two commissions to find out which theory was correct.

VIRULENCE AND PATHOGENICITY

Dr. FARRAR said that in his interesting paper the preceding day Professor Shibayama had told them that he found the Harbin and Changchun strains more virulent than the Dairen strain. He desired to ask whether that corresponded with a longer dur-

ation of the disease at Dairen, and whether the recoveries reported there had anything to do with the lesser virulence of the Dairen strain.

Professor SHIBAYAMA replied that it might happen that some of the Dairen strains were more virulent than others. Perhaps it might be found that some of the Harbin and Changchun strains were less virulent than those found at Dairen. He had only experimented with two Dairen strains.

Professor GALEOTTI asked whether it had been proved that the bacilli isolated during this epidemic of pneumonic plague were more virulent than the usual bubonic strains. He understood that Dr. Strong had found that they were not.

Dr. STRONG said that from his experiments he had concluded that the strains in this epidemic had been of maximum virulence, more virulent than some, and not more virulent than other bubonic strains.

Professor GALEOTTI stated that, as Dr. Strong had said, he did not believe that the pneumonic form was due to greater virulence of the bacillus than existed in bubonic plague. He was of the opinion that the fact that the mortality in the pneumonic form was higher was due not to greater virulence of the bacilli, but to their localization. He thought that the localization of the microbe in the lung produced a more serious disease than its localization elsewhere. It was the same with anthrax and influenza. They knew how serious the pneumonia produced by influenza bacilli was. Probably the plague bacillus found the lungs a very suitable medium, and consequently they produced there a very large quantity of toxin, which found its way easily into the circulatory system and the blood, affecting the heart by coming into contact with it directly. The heart suffered greatly from the action of plague toxins. In conclusion, he might say that he considered the gravity of the epidemic of pneumonic plague depended more upon the special localization of the microbes than upon greater virulence; perhaps this strain was accustomed to growth in the lungs, and that it was a special quality of it to flourish in them.

Professor ZABOLOTNY said that he considered the passage from lung to lung had some effect in the augmentation of virulence.

Dr. MARTINI said that he had studied that phase experimentally. He infected rats by causing them to inhale plague bacilli. At first the virulence of the organism did not reach a high degree. When the strain had been passed through three or four animals, one after the other, it became far more virulent, and perhaps more toxic. At first he killed rats by subcutaneous injection with the strain in seventy-two hours. After four or five passages

through the lungs of the animals the strain would kill rats, infected in the same manner, in thirty hours, when the same quantity of bacilli was used. With intraperitoneal injections the rats died at first in twenty-four hours, and after four or five lung passages, in six to nine hours, and he found in the latter instance that death was due to bacteræmia. There was also more toxicity in the bacilli of the last lung passages. He did not know whether the same result would be found with human beings in cases of plague pneumonia. But it seemed to him that by successive passages through the lungs the virulence and toxicity increased.

Dr. Aspland said that it would be interesting to learn the relation between the virulence of the bacilli and the clinical evidence of an extended incubation period, of which there had been evidence. In the earlier part of the epidemic at Fuchiatien there was evidence to show that the incubation period was not more than three or three and one-half days. Later it ran to five. A curious instance occurred when the epidemic at Fuchiatien was at its height. About 1,100 soldiers were brought up from Changchun, and from clinical appearances it would almost seem that they had brought in a totally different strain. They were accommodated in railway wagons. In the case of other persons in railway wagons at Fuchiatien he believed that the incubation period clearly ran to five days. Alongside them were these soldiers, whose incubation period appeared to be two and one-half days. It was generally spoken of in this case as the Changchun strain.

Dr. Strong said that he would like to ask Dr. Aspland whether the opportunities of infection were not greater during this portion of the epidemic, and also whether the shorter period of incubation among the soldiers might not be attributed to their living under different conditions from those to which they had been exposed before.

Dr. Aspland said that he thought the conditions in the quarantine wagons were considerably better for the soldiers than for the rest of the people, as they had sufficient ventilation, and the number in each wagon was limited.

Dr. Strong suggested that they might have had greater opportunities of infection.

Dr. Aspland admitted that that might be the case, inasmuch as they would have more opportunity of mixing with each other. He drew his conclusions from the time at which it was judged that contact occurred. The soldiers arrived at a time when the death rate among Fuchiatien people was declining.

Dr. Martini said that it was exceedingly difficult to make such a comparison. Perhaps the soldiers sat more together in

the wagons, and if they thus incurred greater chances of inhaling the bacilli it might account for their getting a severer form in a shorter time.

Dr. WU stated that out of 136 soldiers in these quarantine railway wagons, within a space of three weeks, 41 died. Living was certainly healthier in the wagons than in the barracks. There were only 20, or less than 20, men in each wagon.

Dr. FARRAR said that when the epidemic is widely diffused it is almost impossible to draw any conclusion as to what the incubation period has been.

Dr. HILL said that the facts that had been stated were supported by statistics in eighteen different places. Places infected early generally had an incubation period of two to three days. Those infected later had an incubation period of four to five days.

Professor ZABOLOTNY said that he did not consider that it was possible to establish definitely the incubation period, but he did not believe that an incubation period of five to seven days was possible. In ordinary cases observed by him the period seemed to be two or three days, and not more. In all railway-wagon cases they had found the incubation period to be not more than two or three days, and in India, in the segregation camps, cases usually developed in about three days.

Dr. KASAI said that he had found the incubation period in most patients to be about one hundred and twenty hours. There were 53 cases in his observations in which the incubation period was one hundred and twenty-six hours, 20 in which it was six days, 21 in which it was four days, 17 in which it was three, 10 in which it was two, and 42 per cent of the cases appeared to have an incubation period of five days.

Dr. MARTINI said that in railway wagons there was a better chance of infection, as there was every prospect of getting more bacilli into the lungs.

The CHAIRMAN. This is really a question of epidemiology. I will now ask Dr. Strong to close the discussion on the subject of *Virulence.*

Dr. STRONG said that he had really very little to add to what he had said the preceding day. He agreed with Professors Shibayama, Zabolotny, and Martini in recognizing a very high virulence of the organism in this epidemic. The organism was practically as virulent at the close as at the beginning of the epidemic. He believed that the reason the organism had maintained a maximum virulence throughout the epidemic was due to the fact that there had been no intervention of passage through rodents. As Dr. Martini had stated, infection from lung to lung

kept the bacillus at a maximum virulence. He then quoted the results of the experiments given by Professor Shibayama in relation to the virulence of the organism. He (Dr. STRONG) then exhibited tables of his own, showing the virulence of the bubonic and the pneumonic strains. The virulence of the bubonic strain had been tested on 247 guinea pigs. He found that by cutaneous infection some died as early as two days after inoculation and some lived up to six or eight days. One lived eleven days. With strains isolated during the recent pneumonic epidemic the animals died in about the same time after cutaneous infection, some after three or four days and some not until eight or ten days. The Indian Plague Commission's investigations showed that rats infected with a virulent bubonic strain lived about the same time as Professor Shibayama had shown to be the case after the infection of rats with the pneumonic strain. Dr. Strong's experiments on rats had given the same results. Tables of these results and of those of the Indian Plague Commission were shown and compared with Professor Shibayama's tables. He thought this bore out what he had said the preceding day in regard to the virulence of the pneumonic strain.

Professor SHIBAYAMA said that in this epidemic, nevertheless, the microbe seemed to be a little more virulent. The lesions in the organs were better developed than with inoculations from other strains, and the animals died in a little less time.

Dr. STRONG said that, according to the results of the experiments that Professor Shibayama had given details of, the results appeared to be about the same as those of the Indian Plague Commission and those that he had obtained.

Professor SHIBAYAMA said there was very little difference. He killed the animals with big doses of bacteria, and could not see bacilli in the organs. But he could cultivate them. This result depended upon the toxic power.

Dr. STRONG said that he had one guinea pig (which he exhibited to the Conference) that was inoculated six and one-half days before it died. This animal did not show very acute lesions, but the buboes were well developed, and there was no pest pneumonia at all. The spleen was a typical spleen, with miliary abscesses, such as is found after inoculation with bubonic-plague strains. This bore out his statement that cutaneous inoculation of the pneumonic strain would not necessarily cause plague pneumonia. In animals after cutaneous inoculation it usually gave rise to typical buboes and a typical plague spleen, while the lungs remained practically unchanged. When inhaled by these animals, plague pneumonia resulted.

Professor ZABOLOTNY expressed the opinion that the speakers were comparing investigations which were not really capable of comparison. They were comparing cutaneous and subcutaneous infection, and they could not arrive at definite conclusions in that manner. All their experiments should be made in the same manner, giving the same doses by the same methods, and the animals before the inoculation must all be healthy, and placed under the same circumstances. Then they could compare their observations in regard to the virulence of the late epidemic.

Dr. STRONG said that he had always performed his inoculations in the same way in the experiments that he had carried out himself.

Dr. FARRAR then announced that the programme committee would be very much obliged if any Delegates who wished to read papers upon particular subjects on the programme would inform them of the fact.

The Conference then adjourned until the following Monday.

SESSION VI, APRIL 10

PROGRAMME ARRANGED FOR THE DAY

C. Bacteriology and Pathology.
- f. Vitality of the bacillus on inanimate objects.
- g. Resistance to exposure to varying conditions—
  - e. g., drying, sunlight, freezing, alternate freezing and thawing, etc.

2. Infectivity of the plague patient.
   - a. Infectivity of the excreta.
   - b. Infectivity of the breath.
   - c. Infectivity of fleas and other insects parasitic on the patient.
   - d. Infectivity of corpses.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Method of conservation of plague organs for diagnosis.
3. Infectivity of the breath.
4. Infectivity of corpses.
5. Discussion of above papers and other topics of the programme as given above.

PRELIMINARY BUSINESS

The meeting came to order at 10 a. m., Dr. Wu in the chair.

Dr. Farrar said that he understood that it was the opinion of some of the Delegates that the minutes of Session V required revision upon some technical points. He, therefore, moved that they be referred to the editorial committee for revision.

Dr. Strong said that he desired to propose an amendment to this. He suggested that they should consult informally with the Secretary about the technical points. He thought that they all realized the difficulties of work at this Conference, where so many different languages were being employed. and he heartily sympathized with those who had to prepare the minutes. What he suggested was not intended as a criticism. It seemed to him that the minutes hitherto had been very carefully prepared, but there were a few points that might lead to a misunderstanding, if uncorrected, and the minutes of Session V as they now stood might lead to a wrong impression.

Dr. Aspland said that he did not think that any special resolution was needed for this matter. It really came within his department as medical secretary, and he believed that it was the abbreviated form of the minutes that perhaps led to their giving a wrong impression. When the typists who were expected next day had arrived, a fuller summary of the discussions would be prepared and circulated. If those who had complaints of any

inaccuracies would mention them to him, a revision of the minutes would be issued.

Dr. GRAY moved that the minutes of Session V be sent back for revision.

Dr. STRONG, referring to the statement attributed to him in the minutes that the strains in this epidemic were more virulent than some and less virulent than other bubonic strains, said that he could never have made that statement, as it was his opinion that the organism in this epidemic had as high a virulence as this bacillus could reach. He stated, however, that it was not more virulent than some bubonic strains. He seconded Dr. Gray's proposal.

The minutes of Session IV were then passed, and those of Session V were referred to the editorial committee for revision.

On the request of the CHAIRMAN the SECRETARY then read the following telegrams:

"To the Pasteur Institute, Paris: The Delegates to the Mukden Conference, on the opening of the bacteriological section, address their homage to the Pasture Institute and its Chief."

"April 7. The Delegates to the Mukden Conference, on the opening of the bacteriological section, address their homage to the Robert Koch Institute and its Director."

The following telegram dated Berlin, April 8, was received in reply to the latter:

"Cordial thanks. We wish you best success. Koch Institute, Gaffky."

The following telegram dated Peking, April 8, was received from the Union Medical College:

"Union Medical College thanks Conference for kind message of congratulation to college and graduates. We send best wishes for successful conference."

Dr. WU then vacated the chair in favor of Professor Kitasato.

The CHAIRMAN stated that the first paper on the programme for the day was one from Dr. Zlatogoroff on *The vitality of the bacillus on inanimate objects.*

Dr. FARRAR said that he had heard only the preceding day that papers on subsections f and g would be likely to be ready in a week's time. It, therefore, seemed unlikely that the bacteriological sessions could be finished next day.

The CHAIRMAN then called for a paper upon

A METHOD OF CONSERVATION OF PLAGUE ORGANS FOR DIAGNOSIS

By Dr. BROQUET

With reference to the resisting power of plague bacilli against different agents, a question which already has been studied so carefully by Professor Kitasato, allow me to read a little pamphlet which I have recently completed on the preservative action of glycerin solution on the plague bacillus and on a method of preservation of this virus in the plague organs with a view to

facilitating a bacteriologic diagnosis in tropical climates, under conditions where other methods can not succeed with any certainty.

In a communication that we made to the "Société de Pathologie Exotique de Paris" we described a way of diagnosing plague by the conservation of suspicious materials in a 2 per cent solution of glycerin. We think it of interest to relate in this note the result of our researches about the conservation of plague virus in glycerin and the method that we recommend to the distant colonial stations to employ in sending to the laboratory nonputrefied materials. This method enables one to procure a very accurate and rapid diagnosis.

Dr. Soulie, of Algeria [in a note published in the *Bulletin Sanitaire Bimensuel de l'Algérie* (December 16, 1907)], recommended to keep pieces of the spleen of suspicious rats in a sterile flask full of glycerin. We did not know of Soulie's communication when we used this method to preserve and send human plague material for diagnosis, but we never got satisfactory results with pure glycerin.

The Indian Plague Commission recommended Albrecht and Ghon's method for searching for the plague virus in rats. This method is very well known under the name of the method of the "shaved guinea pig." The suspicious material, even when putrified, is rubbed on the shaved skin of the guinea pig, causing the death of the animal if there are any plague bacilli in the material. Fresh virulent material gives positive results in all but 2 per cent of the cases; putrified rats [1] give positive results only in 10 per cent of the cases. We will not discuss here the value of the method which has been confirmed by Dr. Beaumetz of Paris and Dr. Billet of Oran.[2]

However, in tropical countries we think it is better to avoid by all possible means putrefaction of the material. One must consider also its expedition by the post-office as well as its manipulation in the laboratory; besides, we must say that Albrecht and Ghon's method does not always give a rapid result. In the two cases reported by Billet, guinea pigs inoculated by rubbing on the shaved skin died after six and eight days. In two personal cases death took place after six and seven days. Dr. Beaumetz noticed the fatal result after a still longer period, and he considers the result very variable as to the incubation.

[1] Reports of Plague Investigations in India, *Journal of Hygiene* (1907), 7, 334 and 353.

[2] Plague in the Province of Constantine during 1907 by A. Billet, *Annales de l'Institut Pasteur* (1908), 22, 680.

So for our manipulations on human materials we preferred to use glycerin solutions, which gave us always at least as good and more rapid results.

The first time we sent a plague bubo in pure glycerin the inoculations were negative. Then we tried solutions of glycerin of 50 and 25 per cent and we succeeded very well.

We received six human buboes taken out of dead bodies three hours after death, and which had been three or four days in transit. In six experiments after emulsion of a piece of these buboes in a physiological salt solution and injection of this emulsion into a guinea pig and a rat, we observed that the animals died after showing all the symptoms of the disease. In these experiments death took place once after three days, once after three and one-half days, three times after four days, and once after six days. The percentage of the positive results was 100. In these six cases, the intervals of time between the transmission of the specimen from the plague-infected district, distant more than 100 miles, and the telegraphic answers from the laboratory were—

Twice, six days.
Once, six and one-half days.
Once, seven days.
Once, eight days.
Once, ten days.

We next tried to find the percentage of glycerin for the optimum solution and its action on the virulence of the plague bacillus in the following manner: A guinea pig was inoculated on the right thigh with plague material of known virulence. Just after death the spleen of the animal was dissected as aseptically as possible and put into a flask containing the solution for experimentation. After a time, variable according to the condition of the experiment, a piece of the desired organ was cut out, dried on sterile blotting paper and emulsified in 2 cubic centimeters of physiological serum. One cubic centimeter of this emulsion was injected into a guinea pig and one-half of a cubic centimeter into two rats.

The results of these experiments were as follows: It is impossible to kill guinea pigs with a piece of spleen which has been immersed for forty hours in a 50 per cent glycerin solution, and even if such immersion after three or four days has not destroyed the virulence of the bacteria in human buboes, which are large and protected by a thick fibrous envelope, it seems that after a longer time this method would only give negative results.

The solution of glycerin of a weaker percentage (2 to 5 per cent) preserved the virulence of the bacillus up to ten and eleven days.

The 10 per cent solution gave only negative results, and the 15 per cent solution gave a positive result after six, seven, or eight days.

These solutions are very good culture media for foreign germs (*B. subtilis, B. coli, B. pyocyaneus,* staphylococci, and fungi); in them the spleen loses its normal consistence and becomes softened. The hæmoglobin of the blood which remains inside the tissues dissolves and stains the solutions. The solutions become acid, and consequently the bacillus could not be kept alive in them for the purpose of diagnosis.

On the contrary, if we use 20 and 25 per cent glycerin solutions other germs do not grow. The spleen keeps its normal appearance and consistence. The solution remains clear, and, although it gets slightly acid after a few days, it preserves the virulence of the bacteria for eight or nine days. A 20 per cent solution gave us the best results.

For example, a guinea pig dies of plague infection in thirty-six hours after inoculation, and the spleen is removed; its virulence is such that 1 cubic centimeter of an emulsion of it kills a guinea pig in two and one-half days. This spleen is kept in the 20 per cent solution of glycerin at the temperature of the laboratory (from 25° to 28° C.) during eight days; we are then able to kill a guinea pig (of about 600 grams) in three and one-half days after inoculating it with 1 cubic centimeter of an emulsion of a piece of the preserved spleen. The organs of the animal contain plague bacilli in pure culture.

By adding to this glycerin solution 2 per cent of calcium carbonate, the results obtained were still better, and we could preserve the virulence of the materials thirteen days, and, kill a guinea pig in four days with it.

The virus is attenuated by the action of glycerin after exposure to it, and instead of killing the guinea pig in two and one-half days, it kills it after three and one-half or four days.

We used both rats and guinea pigs for our experiments.

The rats belong to a kind living in Annam (Nhatrang), the characteristics of which are as follows: Skin fawn above, whitish-gray underneath; length 24 centimeters, the tail being 13 centimeters; 4 mammæ; ears a little longer than half of the head; weight about 30 grams.

However, the guinea pig is the best animal for these experiments. It dies in three or four days, and post-mortem examina-

tion shows constantly the following signs: Swelling of the thigh on the inoculated side, great enlargement of the lymphatic glands on the same side, often subcutaneous gelatiniform œdema, and hypertrophy of the spleen. The spleen does not show miliary tubercules when the guinea pig dies in three or four days after inoculation, but it is filled with them when it does not die until six days after. In smears made from it, Yersin's bacillus appears in its most characteristic form. In most cases the rat does not react as surely as the guinea pig.

Of the six experiments made with human buboes and with inoculation of both rats and guinea pigs, in one case the rat died a day before the guinea pig (three days instead of four). In a second case both died in the same time (after three and one-half days). In two cases the rat died after the guinea pig (four days instead of three, six days instead of four). In two cases the result was negative, so that if we had only used rats we should have considered as not virulent some materials which were really virulent. Moreover, one finds frequently in the smears of the rats' spleen some granulations stained violet by thionin. These granulations may lead an inexperienced observer to a mistake in diagnosis.

So, although we believe that it is better to experiment at the same time with both the rat and the guinea pig, we consider the latter as being the best animal. This opinion is based not only upon the six cases reported above, but also upon very many other experiments performed with plague. We never saw a guinea pig resist an inoculation when the rat died of the same, but we have often observed the contrary.

The method we use is the following:

1. At any station far from the laboratory a bubo or a part of a bubo is removed from the dead body as soon as possible after death with the strictest aseptic measures, and is put into a large-mouthed flask [1] of a capacity of 150 to 200 cubic centimeters containing 125 to 175 cubic centimeters of the following solution:

Neutral glycerin	cubic centimeters	20
Distilled water	do	80
Calcium carbonate	grams	2

The gland should be put into the flask as quickly as possible, the mouth of the flask and the cork having been passed over a flame according to the usual procedure employed in laboratories for making cultures. The cork is rubbed with paraffin or covered with sealing wax.

[1] Flasks containing the sterile solution are sent by the Pasteur Institute of Saigon to the stations that ask for them.

The flask bearing a number and the date on which the material was taken from the corpse is sent as quickly as possible to the laboratory accompanied by a clinical observation of the case.

As soon as the flask arrives in the laboratory a piece about the size of a square centimeter is cut out with sterile instruments (dissecting mouse-tooth forceps and straight scissors), dried in sterilized blotting paper to remove the excess of glycerin, and triturated and emulsified in 2 cubic centimeters of a physiological serum at 9/1,000 with a thick glass rod in a small conical glass of a capacity of 30 cubic centimeters. Blotting paper which covers the sterile conical glass may be used to dry the piece of the organ.

As soon as the emulsion is completed, it is advisable to let it stand for a time in order to allow the deposit to form so that the needle of the syringe may not be obstructed when the fluid is drawn up. The emulsion is then taken up in a hypodermic Roux syringe of 2 cubic centimeters' capacity, and 1 cubic centimeter of it is injected into the thigh of a guinea pig of 300 to 500 grams, and one-half of a cubic centimeter into the muscles of the thigh of 2 rats.

To summarize: In tropical countries the conservation of plague materials in a solution of 20 per cent glycerin with the addition of 2 per cent of calcium carbonate offers the following advantages:

1. No putrefaction of the material.
2. Any laboratory is able to diagnose plague simply and surely, after three or four days, from material which may have been preserved for thirteen days; that is to say, which may have come from a very distant station.
3. Diagnosis is more quickly obtained than with Albrecht and Ghon's method.
4. It may be used in *medico-legal diagnosis.*

The following paper was then read upon

THE INFECTIVITY OF THE BREATH

By Dr. R. P. STRONG

The experimental work performed on this subject was carried out by Dr. Teague and myself. We commenced these experiments on the first day we began our work in the plague hospital at Mukden, and they were only completed a few days ago.

The object of the present investigation was to show, first, whether in cases of pneumonic plague, pest bacilli become disseminated into the air by the vapor arising from the breath as in ordinary or in dyspnœic respiration; and, secondly, whether

the organisms are disseminated by moderate attacks of coughing of pneumonic cases in which the cough does not result in the expulsion of particles of sputum visible to the naked eye. In the course of the experiments on a number of occasions during coughing, small droplets or larger particles of sputum, visible to the eye, were expelled, and touched the surface of the media of the plate cultures which were exposed before the plague patient. The study of these cultures obviously is not included in this investigation. The cultures were invariably exposed before cases of pneumonic plague with bloody sputum, and in which enormous numbers of plague bacilli had been shown to be present. All of the cases before which the plates were exposed died of plague infection within twenty-four to forty-eight hours from the time of the exposure. Twelve series of experiments have been performed in which seventy-eight plate cultures have been exposed and the microörganisms which have developed upon them studied.

The experiments were performed in the following manner: The plates were sterilized in the hot-air sterilizer within a metal plate holder (such as you see here). They were then removed, the cultures poured in the usual way, and, as soon as the medium was sufficiently hard, were replaced within the plate holder and taken to the patient in whose sputum plague bacilli previously had been found. All of the attendants were asked to retire from the room in order that as little dust as possible might be present in the air. The condition of the patient before whom the plates were exposed was noted, and during the exposure of the plate the character of the respirations were particularly observed and notes made of whether coughing or talking occurred. The time of the exposure of the plate and the distance from the patient were also recorded in each instance. The plate was then returned to the holder and placed in the incubator. After twenty-four hours the cultures were examined for the appearance of colonies and their number counted, but the plates were not opened until after forty-eight or seventy-two hours. The colonies were then again counted and carefully studied. Any of the colonies which in any way resembled colonies of the plague bacillus were transplanted to agar-slant cultures. The morphology and staining properties of these organisms were then studied. In every instance in which the morphology was at all similar to that of the plague bacillus or the organism decolorized by Gram's stain, it was inoculated either into mice or guinea pigs. In a few cases the colonies were so thick on the plate, or surface growths from air contamination with bacteria were so extensive, that the separate organisms could not be isolated and

studied. In these instances a suspension of the whole plate was made, and a portion of the suspension either rubbed over the scarified abdomen of a guinea pig or inoculated subcutaneously into a mouse. On several occasions in which it seemed hopeless to determine whether the plague bacillus was present or not on the plate, owing to the extensive contamination of the culture with air organisms, the animal so inoculated died of plague. In a few instances the plates were discarded because of very extensive contamination from air organisms which covered the whole surface of the plate with a very thick layer of growth. During the colder weather in Mukden, the plates exposed before plague patients during ordinary respiration were frequently entirely sterile. The plates were exposed vertically before the mouth and nose of the patient, the time of exposure varying between two and five minutes; generally the shorter period was employed. In the experiments performed in the earlier part of the investigation the plates were held at a distance of from two or three inches to three or four feet from the mouth of the patient. Later in the experiments, when it became evident that in cases without cough during exposure no plague bacilli were encountered at the greater distances, they were exposed at a distance of from two to four inches in front of the mouth and nose.

I shall not present here, in detail, the results obtained with each plate culture; these will appear when publication of the entire results are made. In thirty-nine instances the plates were exposed before patients who did not cough during the time of exposure, and notwithstanding the fact that many of the patients suffered with marked dyspnœa and advanced œdema of the lungs, in only a single instance was the plague bacillus encountered in one of these plate cultures, although in a number of the experiments the surface of the media was visibly wet by the vapor arising from the breath.

In this one case the conditions of the experiment were as follows:

Three plate cultures were all exposed at a distance of about three inches and for two minutes before a patient with marked dyspnœa and who died two hours afterward. A suspension of the bacterial growth upon one of these plates, which covered almost the entire surface of the plate, was made and a portion rubbed with the side of a scalpel over the abdomen of a shaved guinea pig and the skin then freshly scarified. The animal died of plague infection six and one-half days later; there were inguinal buboes and miliary nodules in the spleen. The animals inoculated with the colonies from the other two plates exposed

in exactly the same manner did not develop plague infection. The results obtained from this one plate are different from those obtained from the remaining thirty-eight plates. Two possible explanations of the result suggest themselves, first, that the plague bacilli reached the plate exposed before the patient in the plague ward in some other way than by the expired air; and, secondly, that the plate was infected with plague bacilli by the droplet method through the forced expirations of the patient during the time this one plate was exposed.

The remaining number of plate cultures (thirty-nine) were exposed before patients who coughed during the time of exposure, and in fifteen instances colonies of plague bacilli developed on the exposed plates. In some cases more than one hundred colonies of this organism were obtained upon the cultures after a single cough, sometimes in almost pure culture.

Guinea pigs, the abdomens of which had been shaved and extensively scarified just before the time of the experiment, were exposed before three cases of pneumonic plague for a period of two minutes and at a distance of two inches from the mouth, the abdomen being placed toward the mouth. The breathing of the patient in all of these experiments was so labored that the hair of the guinea pigs waved back and forth in the breeze made by the expired air, but no cough occurred during the time of the exposure. The animals remained alive, and did not develop plague infection.

The results of all these experiments are in accord with those of Nägel, Flügge, and their pupils whose experiments showed conclusively that by currents of air bacteria are not lifted from moist surfaces, but that in the coughing of tuberculous patients *Bacillus tuberculosis* might become disseminated into the air suspended in fine droplets (droplet infection).

However, these observers concluded that in the case of pulmonary tuberculosis this was not a very practicable or frequent method of infection. In pneumonic plague the conditions are very different owing to the enormous numbers of plague bacilli which are present in the lungs and bronchi. In our experiments performed with cases of marked pulmonary œdema the conditions were also different. The opportunities for infection by means of the droplet method must be very great in a pneumonic-plague ward.

Conclusions.—1. During normal and dyspnœic respiration of primary pneumonic-plague cases, plague bacilli are not usually expelled by means of the expired air.

2. During coughing of such cases, even when sputum visible

to the naked eye is not expelled, plague bacilli in large numbers may become widely disseminated into the air surrounding the patient.

The distance from the patient that the air may be infected by droplets containing plague bacilli varies largely with the strength of the cough, the amount of mucus in the throat and larynx at the time, and the currents of air in circulation in the ward.

The idea that infection of doctors, nurses, attendants, etc., in plague hospitals is caused entirely by particles of sputum expectorated by the patient and visible to the naked eye is erroneous. It follows from these experiments that the wearing of masks and the proper covering of any surface of the skin where fresh abrasions are present are important, personal, prophylactic measures in pneumonic plague. It also follows that the eyes should be protected against this manner of conjunctival infection by proper glasses.

Articles of clothing worn in the wards should immediately be sterilized after removal, since plague bacilli may be present even though no particles of sputum may be visible upon them.

Dr. STRONG then exhibited for inspection two plates that he had exposed toward the close of the epidemic, in each case before patients who coughed a single time. The organisms that had developed upon them had been killed by formalin vapor, and the plates sealed, and were, therefore, quite safe to handle. On both plates very numerous colonies of the plague bacillus were present, on one almost in pure culture.

INFECTIVITY OF CORPSES

By Professor ZABOLOTNY

He said that he had made examinations of the frozen corpses of persons who had died from plague in November and December last. Living plague bacilli were found in them. Dr. Koulecha had studied the matter pathologically and Drs. Tchourilina and Ssouragewskaja bacteriologically. A frozen corpse found near the railway station at Manchouli had been examined by Dr. Brisemski, who had also isolated living plague bacilli from it. At Astrakhan Dr. Chorupoff had found living plague bacilli in corpses six months old. These facts showed how plague bacilli could remain living in the soil, and how rats, tarbagans, and *Spermophilus* could become infected with the germs of plague. They then infected men, and an epidemic of plague resulted. This question of the burial of corpses was, therefore, an exceedingly important one.

This concluded the papers arranged for the morning's work. On the proposal of Dr. ASPLAND, discussion upon *The vitality of the bacillus on inanimate objects* was deferred until Dr. Zlatogoroff's paper on the subject was ready.

The Conference then proceeded to discuss the question of *Resistance to exposure to varying conditions,* with special reference to Dr. Broquet's paper.

DISCUSSION ON CONSERVATION OF PLAGUE ORGANS

Dr. MARTINI stated that he agreed with Dr. Broquet. This preservation of plague material coming from distant tropical regions to the laboratory was very important. He considered this method a very good addition to that of Albrecht and Ghon. It was also necessary to use the latter method, for instance, in carrying on corresponding investigations in places where they could obtain special material immediately.

Professor ZABOLOTNY stated that he also agreed with Dr. Broquet. This was a very important method. He had tried other methods but had not obtained such good results as those described by Dr. Broquet.

Dr. STRONG said that he wished to add that he also agreed with what had been said about the importance of Dr. Broquet's method for preserving plague-suspected material. He would also like to emphasize again the importance of the method of scarification of the shaved abdomen of the guinea pig with the suspected material in relation to the determination of whether or not plague bacilli were present in mixed cultures. He thought that this method was the most delicate test for the presence of the plague bacillus that they knew of to-day. He had sometimes had a whole plate culture overgrown with air organisms, in which he had no idea that plague bacilli could possibly be present. On several occasions, by suspending such culture, and by rubbing a small portion of the suspension over the shaved abdomen of a guinea pig, and freshly scarifying it, a number of the animals had died from plague infection. It was really remarkable how by this method one could discover very small numbers of plague bacilli among such masses of other organisms.

Dr. PETRIE said that he agreed emphatically with Dr. Strong in thinking that the cutaneous method of inoculation was a very good one indeed when other organisms were present. As an inoculation method he did not know any other that was as good. Dr. Broquet's method of preserving material seemed to him to be excellent, but if he had sent to him the putrid spleen of a dead

rat he would have to use Albrecht and Ghon's method. It would be impossible to inoculate subcutaneously from such material because the guinea pig would then die from other causes. Although Dr. Broquet's method was an excellent one, he did not see that it excluded the use of the cutaneous method.

Professor GALEOTTI asked Dr. Broquet if he had repeated these very interesting experiments with pure plague cultures in order to test the vitality of the plague microbes in a medium containing a certain quantity of glycerin; also whether he thought that the plague toxin could be preserved in a glycerin medium.

Dr. BROQUET replied that he had tried for several months to find out whether it would be possible to weaken the bacillus with glycerin and to obtain in this manner a strain capable of immunization without causing death, but he had not succeeded in this endeavor. He had not made any researches on the action of glycerin on the toxin.

Dr. FARRAR said that discussion upon this subsection could not be concluded, because upon it Professor Zabolotny's colleagues also had papers to read, which could not be prepared until a later date.

Dr. WU stated that while in Harbin he had very few opportunities for bacteriological work. During the first few weeks he had one or two opportunities. Perhaps, although his experiments might not be altogether new, they might be interesting. He made some experiments with sputa and cultures obtained from them. The weather was very cold at that time, so that there was no need to experiment with artificial freezing. The thermometer went down as low as -30° C. In the case of the sputa, he left them in agar tubes in a shaded place for three days. In the case of the cultures, he did the same. After three days to such exposure the germs grew just the same, and in the case of the cultures the experiments were done both in a shady place for three days and by exposing the tubes to the cold in the night, and bringing them into the room temperature during the day. In all these cases the bacilli lived.

Dr. STRONG said that he had very little evidence to offer on the point of resistance to freezing. In one instance, however, they had collected plague sputum and left it for one week outside the laboratory. It was frozen on each night, and the following morning was thawed out. After the seventh freezing one loop of it was smeared over the shaved abdomen of a guinea pig, which died of plague after three or four days in the usual manner. Freezing on these occasions apparently had not interfered with the virulence of the organism. The Russian investigators

had published extensively on the resistance of the plague bacillus to cold.

Dr. Aspland suggested that it might be of some assistance to the Conference to read over what had been said upon the points now under discussion by Professor Shibayama. He read extracts from the full report of the proceedings. (See p. 47.)

Dr. Broquet asked whether these investigations of the resistance of the plague bacillus corresponded fully with the investigations made by Professor Kitasato in 1896 to 1897 at Hongkong.

Professor Kitasato said that he had found the same resistance, but his experiments were made with bubo juice and not with cultures.

Dr. Strong asked if anyone present had made experiments with regard to the *infectivity of the urine* in this epidemic.

Dr. Gray asked if any experiments had been made with the fæces.

As no one replied, the meeting concluded that no experiments had been made upon these points.[1]

DISCUSSION ON INFECTIVITY OF THE BREATH

Dr. Broquet expressed the opinion that Dr. Strong's experiments were very important and interesting. The question of a possibility of infection through the conjunctiva had been investigated by Roux and Patzaroff some years ago. The work done by Drs. Strong and Teague was extremely dangerous, and they should be thanked for having undertaken it.

Dr. Christie asked Dr. Strong whether he had come to any conclusion as to the distance which the infection by bacilli could be carried by a strong cough.

Dr. Stanley asked Dr. Strong whether he had found the bacillus on any plates exposed when a patient was speaking.

Professor Shibayama said that Dr. Masson had made some experiments by holding gauze before the mouth of an infected patient, and putting agar plates on the other side. These plates were found to be quite sterile, and it would, therefore, be sufficient to protect the doctor if patients always wore masks over their nose and mouth.

Dr. Broquet said that Professor Shibayama's communication was interesting, but in his opinion the use of a mask for the patient alone would be quite insufficient. Only the preceding night, in company with Professor Zabolotny and Dr. Chabaneix, he had visited a plague patient and put a mask on him. After

[1] For evidence regarding urine see pages 149 and 177, and for the fæces see pages 149, 177, 184, and 186.—[Editor.]

a moment or two, while they were injecting serum into him, the patient took off his mask, and for a quarter of an hour he expectorated and coughed and vomited in the small isolation room in which they were all present, and if the doctors had not been wearing masks they certainly would have been contaminated.

Professor Shibayama said that he quite agreed with this view.

Dr. Hehewerth asked Dr. Strong whether, of the many patients with whom he had made experiments, some had their tonsils affected, and whether when coughing they were infectious. He desired to know whether the mucus of the infected tonsils made the saliva infectious also.

Dr. Petrie said that he considered Dr. Strong and Dr. Teague deserved congratulation for the very thorough way in which they had carried out these experiments. Dr. Strong had mentioned that in some cases he had found his plates contaminated with air organisms. He understood that Dr. Strong had used ordinary agar plates. In England he had used a medium for plating out plague organisms which he had found very satisfactory. This was MacConkey's agar, containing bile salt, mannite, and neutral red as indicator. When one spread material containing plague bacilli upon this plate, one obtained colonies of the plague bacillus of a deep-red color, owing to the fermentation of the mannite. The advantage of this medium was that air organisms grew very badly, if at all. So far as he had tried, these plague colonies were characteristic, because, when one tried to pick them off the plate, the colonies moved *en bloc*. Colonies of cocci also fermented the mannite, and produced red colonies, but these were very soft and easily removed. This medium favored the growth of intestinal organisms and plague bacilli. It might well be that a medium of this kind would facilitate experiments of the sort that Dr. Strong had been carrying out.

Professor Zabolotny said that Dr. Strong's observations were very important and corresponded quite clearly with his practical observations. He might add that when healthy patients sat between suspects their temperature should be taken frequently. They had found that patients became infectious two days after the temperature began to rise. Coughing then commenced. When the temperature started there usually was no danger. Therefore it was very important to take the temperature of all suspects in order to be able to say when they became dangerous. The temperature was a guide as to when coughing and infectiousness began. Taking the temperature might be compared to the experiments with agar plates in proving the infectiousness of the patient.

Dr. KASAI stated that his plague patients always wore a mask.

Dr. CHRISTIE asked if the possibility of infection through the conjunctiva had never been proved by experiment.

Dr. LEWIS asked if all Dr. Strong's experiments had been made with patients who were spitting blood.

Dr. ASPLAND drew attention to the aspect of time in regard to infection. He thought those of them who had been connected with quarantine work must have clearly recognized that even going very near to a patient might not mean that one risked tremendous infectivity. Contact with a plague patient, even apart from his coughing, might or might not be dangerous, according to the time for which the contact lasted. He had in his mind the case of two men, neither of whom was conscious that either of them had plague. They slept together in the usual Chinese fashion, head to head, only their heads touching each other. As far as the history of this incident went, there was no coughing. But one of the men died, and the mere fact of sleeping in that room resulted in the other developing plague in five days. He thought the time of the contact as well as the distance must be taken into consideration.

Dr. STRONG said that he would first reply to Dr. Christie's questions. In regard to the distance from a patient at which infectivity existed after a cough, in his opinion it depended altogether upon the strength of the cough, upon the amount of mucus in the throat at the time, and upon the currents of air in the ward. He thought that a vigorous cough might certainly send out droplets to a distance of several yards. As to the conjunctival type of infection in pneumonic plague, such cases had occurred and had been reported, but he knew definitely of none that had occurred during this epidemic. There had been a case in Bombay where a nurse became infected through a particle of sputum entering the conjunctiva. In answer to Dr. Stanley's question about speaking, none of his plates had been exposed before patients who were speaking loudly. In most of the cases the patients only muttered a few words. He believed that if a patient spoke very forcibly organisms would be expelled in this way. Some experiments performed with orators, in which *Bacillus prodigiosus* has been placed in their mouths, had shown that the bacilli were thrown out into the air for long distances. As regards Professor Shibayama's point that a patient should always wear a mask, he agreed with that. However, patients must remove their masks when expectorating or coughing, and he thought that the doctors should protect themselves as well. But he felt that every patient should be made to wear a mask, in order to lessen the infectivity as far as possible. In reply to Dr. Hehe-

werth's question about tonsillar infection, he could say that in a number of cases in which he had made experiments the patients certainly had not tonsillar infection, as was shown by the post-mortem examination, but he was unable to say that in all of the cases tonsillar infection was not present, as the tonsils had not been examined in all of the cases. As to Dr. Petrie's suggestion regarding special media, he must say that he regretted that he had not had any opportunity of making and using this medium. He would very much like to hear more of Dr. Petrie's experimental work performed with this medium. It seemed to be an important one. As to Professor Zabolotny's remarks, he was glad that his own experiments had borne out the latter's practical observations upon plague. He quite agreed that taking the temperature in the early stages was a very important method for finding suspicious cases. In reply to Dr. Lewis, he might say that all his plates had been exposed before patients with blood in their sputum.

Dr. Farrar said that he would like to suggest that the Conference should consider this question in conjunction with Dr. Murvine Gordon's reports upon the ventilation of the House of Commons. It was found there that a speaker could infect the whole length of the House with *Bacillus prodigiosus*.

Dr. Aspland asked if the speaker was an Irish member.

The question of *The infectivity of fleas and other parasites on the patient* was next considered.

DISCUSSION ON INFECTIVITY OF FLEAS

Dr. Petrie said that he supposed that the infectivity of fleas, if the human flea were meant, would depend largely upon the degree of septicæmia in the case. It would be very interesting, in this connection, to make a quantitative estimate of the septicæmia in cases of pneumonic plague. Such estimations had been made in cases of bubonic and septicæmic plague, and he thought it would be important if similar observations were made in cases of pneumonic plague. In the few instances in which he had seen the blood of pneumonic-plague patients, he admitted that microscopical examination was a rough way of estimating the septicæmia, there seemed to him to be a very marked infection of the blood in comparison to what he had seen of septicæmia in India. Then, of course, the infectivity of fleas depended largely upon their number, and it seemed to be the case that this was the off season for human fleas, so that probably the danger of human fleas carrying infection was not a very great one at the present time for that reason.

Dr. Farrar said that it would be interesting if some of those

who had worked through this epidemic would give their version of the extent to which fleas and other parasites were present.

Dr. WU said that he was unable to give any information upon fleas. During the early part of the epidemic, when the weather was very cold, he had not seen any.

Dr. ASPLAND said that he did not remember seeing a single flea at Fuchiatien, but he would not like to estimate the number of bugs he had seen.

In reply to the Chairman, Dr. PETRIE stated that the Indian Plague Commission had been unable to find it definitely proved that fleas carried bubonic infection from man to man.

DISCUSSION ON INFECTIVITY OF CORPSES

Dr. WONG said that the liver of a plague corpse had been put into ten times attenuated formalin, and before this was done three sections were made through it. Three days afterward another section was made. The surface of this section looked quite fresh, and the plague bacillus could be cultivated from the fresh cut surface.

Dr. GRAY asked if any work had been done on the infectivity of the sputum. In native houses where there had been plague cases blood-stained sputum might be found all over the floor, mats, *k'angs*,[1] etc. Had any investigations been made to ascertain how long it would remain infected?

Dr. WU, referring to Dr. Wong's remarks, asked the size of the liver, because the strength of the antiseptic would bear a relation to that.

Dr. WONG said that it was the normal size.

The CHAIRMAN said that the Japanese doctors had made some investigations upon the point inquired about by Dr. Gray, and they would be presented to the Conference at another part of the programme.

Dr. GRAY asked Professor Zabolotny how many days after death he had examined the corpses he had referred to.

Professor ZABOLOTNY replied that the bodies were buried about three months before examination. Death occurred in December, and the examinations were made in March.

Dr. HEHEWERTH said that he would like to know whether any experiments had been made in the Tropics in regard to the duration of infectivity of corpses. In the Tropics bodies became decomposed in two or three days; the cases reported by Professor Zabolotny were where the bodies had been frozen.

Professor ZABOLOTNY said that he could not recall any experi-

[1] Brick beds.

ments with human beings. Dr. Zlatogoroff had made experiments with putrefied guinea pigs, and found that they contained living plague bacilli a month afterward. He remembered that Dr. Yokoti had worked with mice and rats, and found that after a month all the plague bacilli had died. Generally they lived for a week after death, but in one case he had found living bacilli after a month.

Professor SHIBAYAMA said that the Japanese had made experiments upon this point, and, while he could not give information regarding them then, he expected to be able to do so at the next session.

Dr. PETRIE asked at what temperature Dr. Zlatogoroff made his experiments.

Professor ZABOLOTNY. At room temperature or at the temperature of the incubator.

Dr. BROQUET said that publications that had appeared on the subject of experiments made in the Tropics were of no great value, as they were performed before the method of Albrecht and Ghon was discovered; the method adopted was to attempt to isolate the bacillus on agar-agar, and that method was sometimes insufficient for the search for plague bacilli.

Professor ZABOLOTNY said that Dr. Zlatogoroff made his researches with the method of Albrecht and Ghon, so that it seemed that his investigations were of some value.

Dr. FARRAR asked for an expression of opinion as to how much work could be completed at the next session, and asked all Delegates who were prepared to read papers on sections 3 and 4 of bacteriology to communicate with the programme committee.

The Conference then adjourned until 10 a. m. the following day.

SESSION VII, APRIL 11

PROGRAMME ARRANGED FOR THE DAY

C. Bacteriology and Pathology.
   3. Bacteriological diagnosis of plague pneumonia.
      a. Examination of the sputum.
      b. Examination of the blood.
      c. Lung puncture.
      d. Spleen puncture.
   4. Immunity.
      a. Prophylactic inoculations.
      b. Serum-therapy.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Bacteriological diagnosis of plague pneumonia by examination of sputum.
3. By examination of blood.
4. Vaccination against plague.
5. Prophylactic inoculations with nucleoproteid.
6. Results of prophylactic inoculations with killed cultures at Fuchiatien.
7. Serum-therapy.
8. Results of serum-therapy in experimental pneumonic plague in animals.
9. Discussion of the above papers and other topics of the programme.

PRELIMINARY BUSINESS

The meeting opened at 10 a. m. with Dr. Wu in the chair.

The amended minutes of Session V and the minutes of Session VI were passed.

The Medical Secretary asked the meeting to observe that since the programme had been prepared notice had been given of a paper by Dr. Shibayama upon "The examination of the sputum," and that Professor Galeotti had stated he would like to read a paper upon "Prophylactic inoculations," and Dr. Fang Chin also had a paper on the subject.

Dr. Wu then vacated the chair in favor of Professor Kitasato.

The first subject considered was

THE BACTERIOLOGICAL DIAGNOSIS OF PLAGUE PNEUMONIA BY EXAMINATION OF THE SPUTUM

By Professor Shibayama

There is not very much to be stated upon the question of the examination of the sputa of plague patients. The main question

is in what stage of the sickness the plague bacilli appear in the sputum, and this is a very difficult matter to decide. It is exceedingly difficult to detect the beginning of the disease in coolies. A study of the matter in Japan has shown that plague bacilli can not be found in the sputum in a very early stage of the disease. At the onset of the fever there is very little sputum, and it is then very difficult to discover plague bacilli therein. Even some days later, when the sputum increases and is bloody or of a reddish color, it is difficult to find the plague bacillus, though when this organism is visible it usually is present in pure culture. This condition is almost the same as in the case of croupous pneumonia. In the later stages of the sickness the bacilli take on involution forms, which condition is again similar to that observed in croupous pneumonia, the pneumococci first having a distinct lancet form, but in the end of the disease assuming a spheroid form and losing their capsules. So the plague bacilli often assume a spheroid form at the end of the sickness, and can not be recognized as easily as in the earlier stages. Slides showing this had been on view when the Conference visited the railway hospital.

Professor ZABOLOTNY stated that he agreed with the last speaker that at the beginning of the disease it was very difficult to make an early diagnosis. He recommended decolorizing with Gram's stain. He had also seen involution forms toward the end of the disease, as well as mixed infection in some cases with streptococci and pneumococci. He had observed cases where the bacilli appeared to show bipolar staining when subsequent examination proved that the patient had not plague.

The next subject considered was

BACTERIOLOGICAL DIAGNOSIS BY THE EXAMINATION OF THE BLOOD

By Professor ZABOLOTNY

Generally, cultures of plague bacilli from the blood can not be obtained earlier than forty-eight hours before death. Usually one can not get any culture from the blood in the early stages of the disease, but in the later stages, in some cases, bacilli can be seen upon the slides. As a rule, however, the bacilli are proved to be present by culture. A considerable quantity of blood must be taken in bouillon to be sure of obtaining a growth. With regard to the agglutination test, if agglutination is not found it does not always exclude the diagnosis of plague. I do not think this test can be used in cases of pneumonic plague,

because it is only obtained so late in the disease. Therefore, it is not a satisfactory method of diagnosing plague pneumonia. In bubonic cases I have seen agglutination in the dilutions usually of 1 to 10 and 1 to 15. I remember one case that was very interesting. In this case the diagnosis was made, after the man had recovered, by Drs. Wyssokowitch and Berezny, and they found an agglutination power of 1 to 50. I can not recommend the reaction of the deviation of complement for diagnosis. The most satisfactory method consists in looking for the bacillus both in the sputum and in the blood, and sometimes when it can not be found in the sputum, it can be found in the blood. This is all I have to say upon the subject.

The discussion was opened on the subject of

VACCINATION AGAINST PLAGUE

By Dr. Strong

I have had no opportunity of making prophylactic inoculations during this epidemic, and therefore I feel there are many others present who are more fitted than I am to speak first upon this subject, but at your request I am glad to open the discussion and to give my opinion on this important question. I shall not, however, speak at any length at this time, but will be glad to submit reprints of my investigations on this subject to the Conference if it is desired that I should do so. While I believe that by inoculation with killed pest bacilli, or their extracts, a certain degree of immunity is obtained, I am doubtful whether in man a sufficient degree of immunity to protect him against plague infection is frequently attained in such a manner. I am particularly doubtful of this in regard to primary pneumonic infection. I believe that I have elsewhere shown conclusively that by true vaccination against plague—i. e., inoculation with a living, thoroughly avirulent culture—a higher immunity against plague infection may be obtained than by any other method of prophylactic inoculation. I have also shown that the same culture that produced such immunity in animals was perfectly safe for use in human beings. In regard to recommending true vaccination as a general prophylactic measure against plague during epidemics, I believe that this should not be advised until a culture which has been shown to be perfectly safe for human inoculation and to possess the necessary immunizing power is made a standard culture; such a culture might have international recognition and be placed with some well-known bacteriological institute, such as the Pasteur Institute or the Koch Institute, and placed for distribution or on sale

there for use in different epidemics in different countries. The employment of *only* such a living avirulent culture should be countenanced in vaccination against plague. If this is not done, accidents are liable to happen, since some physician who may think that his organism is sufficiently attenuated may find, on human inoculation, that such is not the case.

Conclusions.—1. Vaccination in plague with a properly attenuated culture is as harmless in human beings as vaccination against smallpox.

2. Such vaccination in man unquestionably gives rise to an immunity against bubonic plague infection.

3. During the present epidemic prophylactic inoculations by means of dead cultures very frequently have been shown to be ineffective against plague infection; some individuals inoculated three times have contracted the disease.

4. It should be one of the duties of this Conference to investigate thoroughly the question of true vaccination against plague.

5. A suitable culture for vaccination against plague should be recognized internationally as a standard culture and placed with some well-known bacteriological institute from which it can be obtained at all times.

6. Vaccination against plague with such a standard culture should alone be countenanced.

PROPHYLACTIC INOCULATIONS WITH NUCLEOPROTEID

By Professor Galeotti

The question of the efficacy of preventive inoculations against the plague is surely one of the most important which we have before us. I believe that this question may be considered as settled in regard to the bubonic form, but the same can not be said for plague pneumonia. On this point many other experiments and observations upon man are required. These experiments could easily be done by infecting monkeys through the trachea, after they had been inoculated with a prophylactic, but such experiments, which are rather difficult and dangerous, have not been carried out, up to the present, in a conclusive manner. From a theoretical point of view we can say that general immunity is not always sufficient to prevent localizations of the microbes in the lungs. In the alveoli of this organ the bacilli find the best conditions for their growth, and are comparatively protected against the bactericidal action of the blood-serum and the phagocytes. It is the same with regard to cholera, and it is known that Koch's bacilli can grow very well in the intestines of subjects whose serum possesses a certain

agglutinative and microbicidal property. It is for this reason that preventive inoculations against cholera in man have never been really successful. Anyhow, if we wish to immunize the human subject against plague pneumonia with a prophylactic, we must use a very powerful one, in order to produce the strongest active immunity. The methods for producing immunity against plague are well known; and it would be superfluous to describe them. But I want to say a few words about the method employed by Professor Lustig and myself. We used for the immunization of animals and man the same plague endotoxin of which I have already spoken of before this Conference. With this nucleoproteid many experiments were made on guinea pigs, rats, rabbits, and particularly on monkeys. Our results were confirmed by Wigoura, and by Tavel, Krumbein and Glücksman, and, therefore, we can state that the pure plague toxin is able to produce a strong active immunity. The blood of animals treated with it possesses a high bactericidal power. The nucleoproteid was tried on man by ourselves, by Dessy at St. Nicola (Argentine), and by Malenchini at La Plata. The Serum Institute at Berne prepares large quantities of this vaccine, which was specially used in Australia at Perth, Adelaide, and Sydney. The advantages of our method are specially the following: First, that the pure toxin can be dried, weighed, and dissolved again in exact proportions; secondly, that by our method we inoculate the only toxin by which immunity is produced and none of the other substances contained in plague cultures, which have pathogenic properties; therefore, with our vaccine we obtain the strongest immunity, together with the slightest general and local reaction; thirdly, that the plague nucleoproteid used for preventive inoculations can be easily obtained and preserved in perfect conditions of sterility.

Before concluding, I wish to add some considerations regarding the efficacy of the bacteria nucleoproteid as a prophylactic medium. With such a substance successful prophylactic inoculations were done against anthrax and against cholera. Schmitz and Helbe state that the cholera nucleoproteid confers in a short time, and without ill effect of any kind, a high degree of immunity, and such results were confirmed by Blell and Kolb, who say that our method of immunization could be used with success for the prevention of cholera epidemics. Lately Schwinpoff was able to immunize guinea pigs against cholera with an endotoxin prepared by our method. With this substance he obtained from the horse a serum possessing strong curative properties for infected animals, and which also lowered the death rate among men affected by cholera from 42 to 29 per cent.

Recent information kindly supplied by Professor Tavel, director of the Institute of Infectious Diseases at Berne, is to the effect that the Swiss Federal Bureau of Health has undertaken comparative practical experiments on different plague vaccines. The commission entrusted with the investigation was unprejudiced by any preconceived theories, and came to the conclusion that all vaccines, if properly prepared, are competent to immunize those species of animals that are most susceptible to plague, but that our vaccine was superior to others in the following respects: Its specific qualities, the facility of dosage of which it admits, and particularly in respect to the fact that it preserves its immunizing properties unimpaired for a considerable period. The commission came to the conclusion that our vaccine was the best adapted to be stored as reserve material against the eventuality of a plague outbreak.

In conclusion, I wish to state that I believe that the best method for producing immunization against plague is the inoculation of the pure plague endotoxin. But without doubt, in regard to the pneumonic form of plague, it is most desirable that the different methods of immunization should again be experimented upon in a comparative manner, in order to obtain a satisfactory solution of the problem as to which is the most important in the prevention of plague.

The following paper was then read

RESULTS OF PROPHYLACTIC INOCULATIONS WITH KILLED CULTURES MADE AT FUCHIATIEN

By Dr. FANG CHIN

The total number of persons inoculated was 439. The number of injections made in each person varied from one to three. Those who were inoculated three times received Haffkine's vaccine twice and Yersin's serum once; those who were injected twice received either Haffkine's vaccine once and Yersin's serum once or on both occasions Haffkine's vaccine, and those injected once received only Haffkine's vaccine.

Those who received three inoculations were 10 doctors, 5 students, and 1 official—16 in all. None of these became infected with plague.

People who were injected twice were 7 doctors, 16 students, 4 officials, and 3 office servants, making a total of 30. No case of plague occurred among them.

The number of persons who received only one injection was 393, namely, 1 doctor, 8 students, 2 officials, 12 merchants, 30 policemen, 308 soldiers, 21 servants, and 11 coolies. Among these, 4 died of plague.

The dates of death after inoculation varied from the shortest period of eight days, to ten, eighteen, or the longest period of thirty-two days.

These results are summarized in the following table:

Occupation.	Number of times inoculated.			Total.
	Thrice.	Twice.	Once.	
Doctors	10	7	1	18
Students	5	16	8	29
Officials	1	4	2	7
Merchants	----------	----------	12	12
Policemen	----------	----------	30	30
Soldiers	----------	----------	308	308
Office servants	----------	3	21	24
Coolies	----------	----------	11	11
Total	16	30	393	439
Deaths after inoculation	0	0	4	[a]

[a] 1 doctor died 18 days after inoculation, 1 student died 8 days after inoculation, 1 soldier died 10 days after inoculation, and 1 coolie died 32 days after inoculation.

SERUM-THERAPY

By Professor ZABOLOTNY

Up to the present we have had experience in the use of anti-plague serum largely with bubonic plague and with a few cases of septicæmic plague, but with very few indeed of pneumonic plague. Calmette used high doses of antipest serum. One case which I wish to record was that of a man who had bubonic plague and septicæmia, and was treated with four doses of 60, 60, 70, and 40 cubic centimeters of serum and was cured. In another case of plague pneumonia the patient also received four doses of 80 cubic centimeters each. This man had septicæmia and plague pustules, but he lived for two weeks after being infected. The third case which I have in mind is that of Dr. Wyznickewitz, who contracted plague pneumonia, and was given intravenous injections of 100, 200, and 350 cubic centimeters. He died on the fifth day. He also had septicæmia. The last case of plague pneumonia I will refer to is that of Dr. Schweiber, who was treated by Dr. Beresnijiev and Dr. Padlevsky. He was given more than 1,000 cubic centimeters without success. I have studied in the laboratory the effect of serum upon monkeys. Doses of 50 cubic centimeters sometimes protect monkeys against bubonic-plague infection. From the experience

gained in the present epidemic, the serum must be injected very early in the disease and in very large doses. I understand this is also Dr. Martini's view. In Harbin several persons affected with plague pneumonia have been injected with vast doses of plague serum. I will refer to two of the cases treated in this way. The first is that of a patient who was given 800 cubic centimeters, and the second, one liter of serum, but neither of these cases recovered. Finally there is a third case in Mukden which Dr. Broquet and myself attended two nights previously. In this case the man was given 400 cubic centimeters of serum, 300 intravenously and 100 subcutaneously. He is still living.[1] My conclusions are that if the serum is to be effective it must be injected into patients and contacts, during the incubation period, and large doses must be injected intravenously and subcutaneously. Where the disease has actually developed, the serum sometimes prolongs life.

The following paper was then read:

THE QUESTION OF SERUM-THERAPY AS APPLIED AT HARBIN IN THE TREATMENT OF PLAGUE

By Dr. P. HAFFKINE

I take the liberty of laying before the present Conference the results obtained by the use of serum in the Harbin Plague Hospital.

I must mention, however, that our clinical observations were much hampered by exceedingly unfavorable conditions and that, therefore, my experiments in a scientific sense can not be considered complete.

The serum used was obtained mostly from Fort Alexander in Kronstadt; that is to say, Russian serum. Not until February did I receive 5,000 cubic centimeters of serum from the Pasteur Institute in Paris.

Serum treatment was applied to forty-two patients. In addition another eleven cases were treated, but it was impossible to make clinical observations on these, and so they are not included in this report.

Of the whole number of patients, nine were subjected to treatment with serum on the second day after they were taken ill. The remainder were taken from the isolation wards, and the first injections were made not later than six hours after the first symptoms of illness had appeared.

[1] This patient died later.—[EDITOR.]

The injections were given for the most part subcutaneously in the abdomen. In fourteen cases intravenous injections were given, but without any difference in the results, as will be shown below.

In addition to the serum treatment the greater part of the patients were given medicinal treatment, such as camphor, caffein, and digitalin in large doses. Sometimes, when there was severe bloody expectoration, adrenalin was injected subcutaneously; morphia was also given; sometimes *argentum colloidale* was given intravenously or *unguentum Credé* was employed. Oxygen, alcohol, and champagne were also given. Antipyretics were used only once.

The quantities of serum injected in each patient varied from 100 to 1,700 cubic centimeters. The serum was injected either alone or, in six cases, together with a physiological salt solution. In two cases when septicæmia appeared, the patient at the time of the intravenous injection was subjected to bleeding from the corresponding vein on the opposite side.

Table I.—*Showing doses of serum in forty-two cases*

Dose (cubic centimeters).	Number of cases.	Dose (cubic centimeters).	Number of cases.
100–200	3	600–700	2
200–300	5	700–800	4
300–400	10	1,000	3
400–500	5	1,300	1
500–600	8	1,700	1

Death resulted in all of the cases treated. It might seem that these results, together with the results of experiments mentioned in the literature in previous epidemics, were convincing enough to discard altogether serum treatment. Still, our experiments have proved, as will be shown below, that it is not advisable yet to relinquish entirely the one hopeful therapeutic measure which we possess.

Injection of large quantities of serum has resulted, first, in an abatement of temperature and, secondly, in an improvement in the general state of the patient. The temperature drops from 0°.5 to 2°.5 C. during the first three hours after the injection. If the quantity of serum injected is sufficiently large, the fall in temperature remains for from 6–9–12 hours. Then it suddenly rises again. This rise is sometimes accompanied by rigors. In one case the temperature was kept down during a whole day,

in two other cases during two days. In these three cases the patients felt so well that they were convinced they would recover, and even the doctors had some hope of this. Then, however, a sudden collapse came. The general condition of the patient improves considerably after the injection of serum. The effect on the heart after injection of large quantities of serum is shown by its stronger and slower pulsations. These results are identical after both subcutaneous and intravenous injections. The infiltration caused by subcutaneous injection gave little pain and the serum was completely absorbed in from 3 to 4 hours, if it was first warmed. The injection of cold serum causes the infiltration to last longer, but not more than nine hours.

Our further experiments have brought up the following questions:

1. Can the pneumonia be arrested or its development retarded by early injections?
2. Does the serum prevent septicæmia?
3. Is septicæmia affected by injections of serum?

Regarding the first question: Observation in sixteen cases has shown that inflammation of one lobe of the lung after serum injection was followed by inflammation of the other lung and other lobes of the same lung. In eleven cases this was proved to happen in from eight to thirty-two hours after the injection.

Regarding the second question: In those cases in which blood was taken and examined at the time of each injection septicæmia resulted in six cases—in one, eighteen hours after the injection; in two, on the second day; in one, thirty-six hours after the injection; in one, on the fourth day; in one, on the sixth day.

We have been able to establish as a general rule that with the development of septicæmia no reaction appears on the part of the organism to injections of serum. This is proved by the cases quoted above. In all these cases the injections of serum were made repeatedly. As soon as septicæmia (confirmed later bacteriologically) appeared, there was a complete absence of reaction after the injection of serum.

We also made the following experiment: Of seven Chinese patients on the second day of their illness, who were very weak and had a temperature of not less than 39° C., four were injected intravenously with 200, 300, 400, and 500 cubic centimeters of serum, and three were left without treatment for comparison. The results were in all cases the same; that is, the condition remained unchanged until death.

TABLE II.—*Serum injections in septicæmic cases*

No.	Dose of serum.	Temperature.				Death at—
		9 a. m.	12 m.	3 p. m.	6 p. m.	
	c. c.	°C.	°C.	°C.	°C.	
1	200	39.0	39.2	39.9	----	7 p. m.
2	300	39.2	39.6	40.0	40.1	9 p. m.
3	400	39.4	40.1	40.0	----	6 p. m.
4	500	39.7	39.6	39.8	----	7 p. m.
5	None.	39.0	39.7	39.4	39.9	10 p. m.
6	None.	39.5	39.6	40.2	----	8 p. m.
7	None.	39.8	39.8	----	----	5 p. m.

In connection with the question of whether the use of serum may prolong the period of sickness, we obtained the following data: During the month of January, 1911—that is, when the epidemic was at its most virulent period—the average number of hours spent in the hospital before death by patients who were taken from the isolation wards at the moment when the disease was established was 16.9. The average number of hours of twenty-four patients treated with serum in January was 46.2.

TABLE III.—*The duration of the disease in treated and in untreated cases*

Duration of disease (January, 1911).	Injected with serum.	Not injected with serum.
Longest period	6 days, 12 hours	3 days, 11 hours.
Shortest period	33 hours	6 hours.
Average	46.2 hours	16.9 hours.

Among the whole number of persons treated with serum the longest duration of the sickness was observed in the case of the student Beliaieff—six days twelve hours and ten minutes; the shortest duration was thirty-three hours. The longest duration for nontreated cases was three days and eleven hours, the shortest (in a case of *pestis siderans*) was six hours.

A few words on the temperature following the reaction of the early injection of serum: Plague bacilli were found in the sputum of a patient on the third day after her husband's death from plague. The temperature was then 36°.7 C. No physical signs of pneumonia were present. An immediate injection of 300 cubic centimeters of serum was made at 9 a. m. Until 6 p. m. the temperature gradually rose to 39°.4 C. During the night abortion took place. In the morning the temperature fell to 37°.4 C.; in the day it registered 38°.6 C. The sputum was strongly colored with blood. In the evening she died.

Other cases have shown the same results. If the injection was

made when the temperature was low, only a slight rise was noted, but the progress of the disease was not stopped by the injection.

The same may be said regarding the injection of small quantities of serum during the period of incubation. Of three cases two had serum injected one day and one sixteen hours before the disease was apparent, but the development and progress of the infection was as usual.

Lastly, serum in quantities of 75 to 150 cubic centimeters was used as a prophylactic. The injections were made in the case of persons who were in very close contact with the sick. Altogether forty-six injections were made. Of these three died (as above mentioned).

The following comparison of the prophylactic action of the serum and the susceptibility among the noninoculated is also characteristic.

First group.—Out of twelve helpers who were in the closest contact with a sick comrade and who had serum injected in quantities of 100 to 125 cubic centimeters, only one was taken ill.

Second group.—Out of thirty persons who were in the same conditions, fourteen were inoculated. Three of this group were taken ill—two after twenty-six days and the third on the twenty-fourth day after inoculation. Of the sixteen noninoculated six were taken ill, and, furthermore, by contact, another five, making the total eleven.

Third group.—Out of eighteen, seven were inoculated, one was taken ill. Of the remaining eleven noninoculated, five were taken ill. I shall mention here the cases of two patients which are not included in the general figures. Both were by mistake brought to the hospital. One had croupous pneumonia; he lay in a ward with other plague patients for three days, and had 600 cubic centimeters of serum injected. The other had fœtid bronchitis and emphysema; he remained four days in the ward and had 400 cubic centimeters injected. Both were duly released after recovery.

I wish also to add a few words on the different kinds of serum. The comparison of the Kronstadt and Paris serums has shown that the latter is more efficient as regards the temperature reaction. We used it in three cases undiluted and in one case together with Kronstadt serum and a physiological salt solution. In all cases the temperature was lowered by not less than 1° C., in one case by 2°.5 C.

Some batches of serum were more active than others. An early serum illness in a plague patient has been observed in one

case only (Sniejkowa). After injection of 1,700 cubic centimeters of serum, erythema, violent itching, and pains in the joints with œdema appeared.

In the prophylactic injections we had several cases of serum illness. Some persons were so sensitive that a dose of 20 cubic centimeters (by the combined method) sufficed to make them ill. In two cases, after subcutaneous injection in the abdomen of 150 cubic centimeters of serum, we observed violent serum disease on the fourth and fifth days after injection. Both had high temperature, severe, painful œdema of the abdomen, skin, scrotum, penis, and urticaria, and pains in the joints, which became swollen. The sickness lasted in one case for eleven days, in another for seventeen days.

Of course it would be rather premature to base conclusions on the insignificant number of experiments quoted, as statistics based upon such a small number can not be generally relied upon. However, I have been led to the following conclusions:

1. In pneumonic plague at Harbin serum treatment gave no result, owing to the great virulence of the disease, causing at a very early date of the sickness irreparable damage to the tissues and organs, especially of the nervous system.

2. One must not stop the use of serum in the early stage of pneumonic plague, and its use must be continued in the future because, (1) of the doubtless beneficial reaction to the organism on the injection of serum; (2) the average length of the sickness becomes more than doubled when serum is used. Researches must be carried on in connection with the use of very large quantities of serum and with serum of a higher potency.

3. With the appearance of plague septicæmia there is no temperature reaction on the part of the organism after an injection of serum.

4. Injection of small quantities of serum in the incubation period does not stop the progress of the disease.

5. The use of serum as a prophylactic does protect in a certain measure from infection, but only for a short time (less than twenty-four days). The quantity injected must be more than 150 cubic centimeters. Such inoculations must be recommended to persons who are in close contact with plague patients.

The following paper was then read:

RESULTS OF SERUM-THERAPY IN EXPERIMENTAL PNEUMONIC PLAGUE IN ANIMALS

By Dr. Martini

About ten years ago I studied the effect of Paris antiplague serum in the case of experimental plague pneumonia in the fol-

lowing animals, mice, guinea pigs, rabbits, cats, gray rats (*Mus decumanus*), and white rats.

Many inhalation experiments were carried out and many control animals were used, because complete evidence was desired on this very serious question. Perhaps it might be of some interest to hear what was determined at that time. Therefore, I will give a short résumé of my publication in 1902 upon this subject.

RESULTS OF THE PREVENTIVE INOCULATIONS WITH ANTIPLAGUE SERUM

1. Regarding rats it was found that antiplague serum in the amount of about one-sixtieth part of the body weight was sufficient as a protective dose; serum in the dose of one-fortieth part of the weight of the body did great harm to the animals, owing to the toxic effect of the high dose of serum itself.

2. In the experiments concerning the duration of the protection of rats and guinea pigs, it was found that the resulting complete protection with the above-mentioned doses of one-sixtieth part of the body weight existed generally only for two days; such protection was sure for rats and uncertain for guinea pigs. It was also certain that protection did not last longer than five days after the inoculation. I will not go into further details about the life-prolonging effect of the serum after five days; its value after this time is always doubtful.

After these experiments on animals it was possible to conclude with some degree of certainty for human beings that the doses of antiplague serum used up to that time (10 to 20 cubic centimeters) do not give in any way a protection against plague infection entering through the lungs, as man has about as little resistance against pneumonic plague as the rat. This may be seen from a comparison between clinical experience and the experiments with animals. If, therefore, a protective inoculation with plague serum is to be used against a lung infection, there ought to be injected (according to the above-mentioned experiments) 1,000 cubic centimeters of plague serum for a human being of 60 kilograms in weight. Such an injection is practically impossible. However, it is improbable that an infection of a human being will ever happen with such large quantities of bacteria as are sprayed in the inhalation apparatus; so that, after all, perhaps smaller doses of plague serum will be sufficient for protection. A protective result can not be expected if doses smaller than 100 cubic centimeters are employed for a human being.

These conclusions are disappointing in regard to the employment of serum treatment in pneumonic plague. However, because conclusive experiments on human beings do not exist, which demonstrate success with the small doses of serum which

had been recommended, we must for the present employ higher doses.

Another disappointing feature is the fact that the protection afforded by the serum does not last even in rats with certainty for five days after the injection. Moreover, it disappears after eight days. It was supposed up to this time that human beings, rats, and mice were protected after such passive immunization for from fifteen to eighteen days. Finally, we wish to point out that there is some experimental evidence of the efficacy of plague serum. Injections in rats, in doses of one-sixtieth of the body weight, given one hour before the experimental infection by inhalation or during the incubation period, twenty hours after inhalation, have given in all cases good results and in fact complete protection.

RESULTS FROM EXPERIMENTS WITH INJECTION OF THE SERUM AFTER THE INFECTION

The plague serum did not produce practically any curative effect when injected into animals suffering with pneumonic plague. This also has been stated to be the case in human beings. Large and small doses had no other effect than perhaps slightly to prolong life in those cases where large areas of the lungs were not immediately infected.

The action of the serum is mostly bactericidal, and the more numerous the bacteria are present in the large infected areas of the lung, the more poison enters the organism from the resulting destruction of the bacteria. Hence death is hastened by the bactericidal action of the plague serum. If the bacteria are present in small numbers, the serum inhibits the growth of them for a time but does not destroy them; after two to four days this inhibitive effect ceases; the growth of the bacteria then recommences, and death always occurs though it may sometimes be delayed.

From the above experiments we can conclude for human beings:

1. Those in danger of infection by coming into close contact with pneumonic plague patients—for instance, doctors and attendants, especially when the people are confined in a small space, as on board a ship—should be immunized with plague serum.

2. The dose of serum should not be under 100 cubic centimeters, and should be given immediately if any favorable result is to be obtained. It should be injected subcutaneously over the abdomen in different places.

3. If possible, an active immunization with a dead agar culture of plague bacilli should follow the serum injection on the

next day. The active immunization is more effective, and is protective for some months. This active immunization should be employed in cases when, for instance, the attendants have to be longer than two days in the presence of the plague patients. The passive immunization with plague serum disappears, and its protective effect is lost after a few days. It is recommended to keep killed plague agar cultures, suspended in a physiological salt solution and in doses of 2 cubic centimeters, always ready for use.

4. It is not possible as yet to make this immunization obligatory; for the present, results on both man and animals do not justify this, and the serum at the present time is not even controlled in Germany by the Government.

5. During an epidemic of plague pneumonia, human beings who are treated with plague serum within the incubation period will probably have a not unsatisfactory prognosis, provided the treatment with large doses of plague serum is given, at the latest, twenty-four hours after the entrance of the plague bacilli into the respiratory tract. Treatment with 100 cubic centimeters serum (50 cubic centimeters subcutaneously and 50 cubic centimeters intravenously) would seem to be useful in such cases.

Individuals into whose faces plague patients have coughed, and also those who live in close contact with such patients and fall sick with prodromal symptoms of the infection, should receive an intravenous injection of serum. The plague serum thus enters through the right ventricle and the pulmonary arteries, and very soon reaches the lungs.

6. In any stage after pneumonic plague has already become manifest, and when, for example, the sputum is already bloody and plague bacilli are present in it, the treatment with plague serum scarcely offers a chance of saving life; such treatment might, perhaps, in some way comfort the patients, but life is in most cases lost.

I have quoted these pages of the publication in full because I have the impression that the conclusions reached at that time have received a general confirmation from our later experiences in man.

Serum-therapy in human beings during the present epidemic of plague pneumonia has shown what was predicted from these experiments with animals, an example of the value that animal experiments can have.

1. A small protecting power of the specific serum, and this only when exceedingly high doses were employed.

2. Therapeutic effect in the incubation or first period of infection when extraordinarily high doses were employed.

3. No curative value at all in well-developed cases of plague pneumonia. Mere prolongation of life in some cases can not be an argument in favor of the method as a proper means of treatment.

DISCUSSION ON PROPHYLACTIC INOCULATIONS

Dr. FARRAR said that in connection with the subjects discussed that morning the Conference had a very solemn duty to perform. Before it closed it would have to draw up definite resolutions upon the subject of prophylactic inoculations. China expected the Conference to make recommendations upon this point. He thought that it would be impossible to come to any definite resolutions in the course of a discussion of this kind, and he therefore suggested that a committee be formed to sift the evidence before the Conference as to the efficacy of prophylactic inoculations and the degree of safety with which they could be used, and to draw up a resolution to be submitted to the Conference in full session.

Professor GALEOTTI seconded this proposal.

In the course of discussion upon this point Dr. FARRAR added that the matter could not be adequately threshed out except by a committee sitting daily to examine one by one the different methods. This committee would then be in a position to submit a definite resolution to the Conference. China expected some distinct recommendation upon this point.

Dr. STRONG said that the suggestion would be quite agreeable to him. It would take a very long time to examine all of the evidence. The proposed committee could go thoroughly into the matter and then submit it to the Conference for discussion. Professor Galeotti and he were both interested in different methods, and therefore neither of them should be members of this committee. He suggested the names of Professor Zabolotny, Dr. Martini, and Dr. Petrie, and it would be a good idea to include also a Delegate who was not specially interested in any particular method of prophylactic inoculation, perhaps Dr. Farrar. He also suggested the name of Dr. Broquet as a member of this committee.

Dr. GRAY suggested that Dr. Stanley should also be included, as he had had experience in the effect of inoculation upon the people under local conditions.

Professor ZABOLOTNY thought that the whole matter should be discussed by the Conference.

Dr. GRAY thought that Dr. Farrar's resolution might be deferred until the subject had been discussed by the Conference.

Dr. STRONG said that he was quite agreeable to that course also.

The CHAIRMAN put Dr. Farrar's resolution to the meeting and declared it carried *nem. con.*, but no steps were taken to elect the committee.

Dr. ASPLAND suggested that before the discussion upon the papers that had been read continued, the Conference should express its opinion that Dr. Strong should be requested to submit the reprints he had mentioned upon *Prophylactic inoculations* to the committee on prophylactic inoculation. Carried by acclamation.

DISCUSSION ON BACTERIOLOGICAL DIAGNOSIS FROM EXAMINATION OF THE SPUTUM

Dr. STRONG said that Professor Zabolotny had mentioned that he had noticed the presence of bipolar staining organisms in cases which were shown afterwards not to be plague. He would like to ask whether these organisms were decolorized by Gram's stain. As regards what Professor Shibayama had said about involution forms of the bacillus in the sputum in the later stages of the disease, he had also made the same observations, and this proved in another way that involution forms might have nothing to do with the virulence of the infecting organism, but were the result of the struggle between the infecting organism and its host. He desired to emphasize the importance of Gram's stain in diagnosis from the sputum. As a routine clinical method in the diagnosing of pneumonic plague he always used Gram's stain at one end of the specimen on the slide and at the other end he stained it with dilute carbol-fuchsin. Gram's method was often of great assistance in making an early diagnosis as a routine clinical procedure.

Professor ZABOLOTNY stated that he had made a Gram's stain, and sometimes found Gram-negative organisms when bacteriological and cultural tests showed that it was not plague.

Dr. MARTINI said that during the last epidemic he had found, in the sputum in Shantung, bipolar bacilli which looked like plague bacilli. He had infected rats with the culture of the organism and they died with plague-like symptoms in five days. Of course that was a much longer period than when they died with real strains of the pneumonic-plague organism. He had then studied the question further, and found that it was not plague at all. This was a very interesting point.

Dr. STRONG said that he thought that such cultures ought to be very carefully studied, and as much information as possible

obtained upon these points. If Dr. Martini could give them a further account of this organism it would be most interesting.

Dr. Martini said that he had the culture, and it could be studied.

Discussion on Bacteriological Diagnosis from Examination of the Blood

Dr. Kasai said that one of his colleagues reported that out of eight cases he had studied he had found bacilli in the blood in only five.

Dr. Strong asked Dr. Kasai at what stage the bacteriological examination of the blood was made. In his own examinations of the blood just before death, or at death, in thirty pneumonic cases he had always found plague bacilli in the blood in every instance. He therefore desired to know whether these examinations of the blood were made at an earlier period than forty-eight hours before death.

Dr. Kasai stated that he could not say at what time the examinations of the blood were made. It was possible that they had been made in the first stages.

Dr. Wu said that he had some facts he wished to place upon record. He had examined 268 cases altogether, both during the first two weeks at Harbin and the last three weeks. He made a practice of examining specimens of the sputum and blood in each of these cases in the hospital. These cases gave the following results: In 52 per cent plague bacilli were present in both blood and sputum, and in 6 per cent bacilli were present only in the blood. There were four cases in which patients had complained of diarrhœa, and he had examined these cases, and found suspicious bacilli in the fæces. In one case they appeared to be quite pure plague bacilli. He was sorry that he had not been able to divide the cases up by dates, etc. The results from the examination of the specimens were just the same in the early as in the later stages, and were between 50 and 55 per cent.

Dr. Haffkine said that Dr. Predjezimski had seen plague bacilli in the blood, microscopically, on the first day in six cases, and these all died on the same day.

It being now nearly 12.30 p. m. the Chairman announced that he was prepared to receive propositions in regard to the discussion of the rest of the morning's programme.

Dr. Hehewerth proposed a second session in the afternoon.

Dr. Broquet suggested that the discussion should be continued and completed now.

Dr. Aspland put in a plea for mercy on the part of the clerical staff, who would be quite unable to keep up to date if a session were held that afternoon.

Professor ZABOLOTNY was opposed to a session in the afternoon, as he had work in the hospital.

Professor GALEOTTI seconded Dr. BROQUET'S suggestion, which was carried.

Dr. GRAY mentioned that Professor Zabolotny had stated that plenty of blood was necessary to inoculate bouillon for plague cultures, and asked what quantity was necessary.

Professor ZABOLOTNY. At least 1 cubic centimeter.

Upon *Lung puncture* and *Spleen puncture* there was no discussion.

DISCUSSION ON VACCINATION (continued)

Dr. BROQUET. There is no doubt that the vaccination method which Dr. Strong has studied so well and has just described seems to be the ideal method. I wish that Dr. Strong would not confine himself to generalities upon this method, which he knows so well, but that he would give us details of the method that he has introduced, and the results of his experiments proving the efficacy of this method and proving that living cultures can immunize without danger. I think that it is absolutely necessary, in order to settle so important a question, to experiment in all countries with prisoners, who are under sentence of death, with the methods of preventive inoculation already known and with the method of living cultures advocated by Dr. Strong, and that afterwards they should be inoculated with virulent bacilli. Then we could determine accurately the value of the various methods, and we would be sure of the harmlessness of living cultures in man. For the moment our information on protective inoculation is based only on statistics, which are subject to many mistakes, and do not permit us to draw scientific conclusions, but we ought to guard against preventive inoculations being pronounced a failure by scientific persons at this Conference without sufficient evidence.

Professor GALEOTTI said that if he was not mistaken, Dr. Strong advocated the use of living cultures for injections into men.

Dr. STRONG. Living attenuated cultures under certain conditions.

Professor GALEOTTI said that he would like to put this dilemma before Dr. Strong: Either the bacilli he proposed to use could develop in the human tissues or they could not. In the first case, to inject them would be exceedingly dangerous. For himself, he would not like to be inoculated with living cultures. In the alternative, if the microbe did not develop he did not see any advantage in injecting living cultures instead of dead cultures,

or the pure toxin. They knew that antibodies were formed by the tissues, under the stimulus of the toxins, and that immunity depended upon the quantity of these antibodies formed; and, secondly, that the quantity of these antibodies was in proportion to the quantity of the antigens. Therefore, in his opinion, it would be much better for producing a high degree of immunity to introduce a large quantity of toxin or dead culture instead of a small quantity of living bacteria.

Dr. STRONG said that Professor Galeotti's observations on this subject had been most interesting, but, after all, they were largely theoretical. The most important thing was the practical result. The practical results obtained by immunizing with living, attenuated plague cultures showed that the highest immunity was attained by this method. He was not alone in making this statement. The subject had been worked on carefully by Kolle and his assistants, who had made the same observations. The only important point just now was the question whether this method was a safe one for introduction, and he would like to have this point considered. If they were allowed to use this method during an epidemic of pneumonic plague, the results would show whether it was of any great value or not. In regard to the question whether very attenuated organisms multiplied after inoculation, they certainly lived sometimes for as long a period as twenty hours after inoculation, for he had been able to find them after this length of time in vaccinated animals by making cultures from an incision near the point of inoculation. This demonstrated that the organisms had survived for a few generations and that the successive generations and the products to which they gave rise had aided in producing immunity. He believed that in vaccination against plague the living organism, surviving for a short time in the tissues of the host, gave rise in some way to a much greater immunity than the inoculation of previously killed organisms did. How the increased immunity was produced was a theoretical question which at the present time he did not care to discuss at length. The actual value of the method of immunization was demonstrated by the protection it afforded. He did not want the fact lost sight of that he believed that all the methods of inoculation referred to gave a certain degree of immunity. He believed that Professor Galeotti's method did give some immunity against plague, and that a number of other methods, including Professor Haffkine's, also did. All he claimed was that by the use of a true vaccine a higher degree of immunity against plague might be obtained. In reply to Dr. Broquet, he would be glad to give to the vaccine committee all the information regarding the de-

tails of the method and the results obtained. Much of this had already been published.

Professor SHIBAYAMA said that he thought it had been proved by experiments with animals that the living culture gave a better degree of immunization, but precautions must be taken to insure that there was no loss of human life by these inoculations. Many vaccines had been prepared in Tokyo, but they had been unable to judge of their success until now. He had made experiments with Professor Galeotti's vaccine, but he did not favor it very much because it caused the loss of a great deal of material, took a long time to prepare, and had no special advantages. He preferred a culture on agar killed by heating to 65° C. to Professor Galeotti's method.

Professor GALEOTTI said that he would like to reply to Professor Shibayama. The method adopted by Dr. Strong was similar to the method tried by Pasteur for anthrax in cattle, which was discarded as being too dangerous. It was found that it was safer to produce immunity against anthrax with dead cultures. He believed that by the proper treatment of man with the toxin of dead bacteria a high degree of immunity could be obtained without the danger attending the injection of living cultures. He had already referred to the comparative tests carried out by the Swiss Commission, which had found that his endotoxins produced a very high degree of immunity. He did not think the preparation of this toxin was very difficult or that there was much loss of substance. It was only a question of practice. At Berne it was produced in large quantities for commercial use, and he did not believe that there was more difficulty in preparing it by his method than by the German method.

Professor SHIBAYAMA said that during this epidemic they had required as many as 10,000 doses a day. They could not afford that by Dr. Galeotti's method.

Professor GALEOTTI said that one of the advantages of his prophylactic was that it could be preserved in its dried form for many months, and thus it was convenient to keep a reserve supply. Other prophylactics, which were suspended in water, lost their immunizing powers in a short time.

On the proposition of Dr. FARRAR, the meeting was adjourned until 10 a. m. the following day, when the subject of *Morbid anatomy* would be taken up.

SESSION VIII, APRIL 12

PROGRAMME ARRANGED FOR THE DAY

C. Bacteriology and Pathology.
4. Immunity.
a. Prophylactic inoculations.
b. Serum-therapy.
5. Morbid anatomy especially in relation to the mode of infection in plague pneumonia.

SUMMARY OF PROCEEDINGS OF THE SESSION.

1. Preliminary business.
2. Serum-therapy in Bombay.
3. Discussion on prophylactic inoculations (continued).
4. Discussion on serum-therapy.
5. Aspects of question of prophylactic inoculation against pneumonic plague.
6. Prophylactic and therapeutic plague serum injections and agglutination; discussion.
7. Morbid anatomy.

PRELIMINARY BUSINESS

The minutes of Session VII were adopted, and Professor Kitasato then took the chair.

The Medical Secretary pointed out that there were one or two alterations to be made in the programme for the day. Professor Galeotti desired to read a paper upon the subject of serum-therapy. It was in the hands of the Conference whether this paper should be read at this session or whether it should be accepted as read and added to the report of the preceding day. In section 5 Dr. Martini's paper would come third, and a paper by Dr. Wang would come last.

Dr. Strong proposed, and Dr. Gray seconded the proposal that Professor Galeotti should be permitted to read his paper.

Professor Galeotti read only the conclusions of his paper, but submitted the paper which follows for inclusion in the records.

SERUM-THERAPY IN BOMBAY

By Professor Galeotti

In regard to the serum-therapy of plague I believe that it would be of some value to consider a short account of the experiments made in Bombay with a serum prepared by following the method proposed by Professor Lustig and myself. This method chiefly

consists in inoculating the plague endotoxin (nucleoproteid) into horses. After several injections of proper quantities of toxin the animals are bled and the serum collected according to the general rules.

The first experiments were carried out on different animals, and the good results obtained encouraged us to try this serum on human beings. From the year 1898 to 1899 a great many cases of the different forms of plague were treated, and I was assisted in these investigations by Polverini and Mayr.

Dr. Choksy, whose name is so widely known in regard to plague and who was in charge of the plague hospitals in Bombay, took a very active part in our experiments, and looked after the publication of the official reports and of several pamphlets and papers on the subject.

In 1898, 175 plague patients were inoculated with the serum furnished by four horses immunized in Bombay. The results may be seen from the following table:

Serum of horse No.—	Number of patients treated.	Deaths.	Recoveries.	Percentage of recovery.
1	71	53	18	25.35
2	30	14	16	53.33
3	54	25	29	53.70
4	20	8	12	60.00
Total	175	100	75	42.85

It is to be noted that out of these 175 cases 18 were in the worst condition at the time the curative injections were given. If these 18 hopeless cases are excluded, the death rate among the treated patients falls to 53 per cent, while the general mortality among plague patients at that period of an extremely virulent epidemic was (as may be seen from the official statistics) about 94 per cent.

Afterwards other cases were treated in the hospitals and in private practice, as shown in the following table:

Where treated.	Number of patients treated.	Recoveries.	Deaths.	Percentage of recovery.
Arthur Road Hospital	403	154	249	38.21
Maratha Hospital	28	11	17	39.28
Government House Parell	12	3	9	25.00
Private	32	19	13	59.37
Total	475	187	288	39.36

The percentage of recovery was therefore 39.36.

The results appear in themselves satisfactory if we compare them with the following figures:

At the Arthur Road Hospital during the same period 1,109 patients were treated without serum, 233 of whom recovered, or 19.57 per cent.

At the Maratha Hospital 3,378 patients were similarly treated, of whom 646 recovered, or 19.12 per cent.

At the Modikhana Hospital 1,384 patients were treated, of whom 295 recovered, or 21.31 per cent. A comparison of these results shows that while the average percentage of recovery in the hospitals among the cases without serum was 20.06, among those receiving serum it was 39.36—that is, out of 100 cases 19.70 per cent recovered only in consequence of the serum treatment.

It must be added that many of the patients treated with the serum were brought to the hospital in a very bad condition and beyond any possibility of recovery. The efficacy of the serum was much more manifest in private practice, when the curative inoculations were made as soon as the first symptoms of plague developed. While these preliminary experiments were carried on, the Indian Plague Commission proposed to us to use the so-called *alternate system*—that is, to inoculate with the serum every second patient, as they were brought to the hospital, reserving the other ones as control cases, without serum. Excluding all the moribund cases from both series the results were as follows:

Cases.	Number of patients treated.	Deaths.	Recoveries.	Percentage of recovery.
Serum	313	189	124	39.62
Nonserum	297	237	60	20.21

The difference, therefore, in favor of the serum treatment is 19.41 per cent, and this represents the actual value of the serum in those cases which are really fit for treatment.

As regards the pneumonic form of plague, we had occasion to treat four patients with serum, all of whom died.

In the septicæmic cases the serum treatment is of little value. The recovery can follow only if the patients are treated at the very beginning of the disease. Of 57 cases treated by us only two recovered. However, we could ascertain that the serum is able to prolong the life of the patients. I remember having seen patients suffering from plague septicæmia who were kept

alive for twelve to fifteen days by means of daily inoculations of 50 to 100 cubic centimeters of serum. The microbes in the blood diminished or disappeared after every injection, but reappeared afterwards. Death resulted as soon as the serum treatment was stopped.

The *conclusions* which can be deduced from the above observations are the following:

1. That the serum prepared with the method proposed by Professor Lustig and myself exerted a distinctly favorable influence on the course of the disease.

2. That in the hospital practice, which can be considered an unfavorable one, the rate of recoveries was higher in the patients treated with serum than in those without serum treatment. The difference is about 20 per cent in favor of those treated with serum.

3. That the use of serum is far more satisfactory in early cases. For this reason in private practice the percentage of recoveries was 59.37.

4. In septicæmic cases if the serum fails to avert death it is able to prolong life and to ameliorate temporarily the condition of the patient.

5. The serum had no effect in pneumonic cases.

Professor Galeotti repeated that of 57 patients treated for septicæmia only two recovered, and that the serum had not had any effect upon four pneumonic cases.

DISCUSSION ON PROPHYLACTIC INOCULATIONS (continued)

Dr. Broquet. We have not spoken in this discussion either upon the reaction given by vaccines or upon the study of the size of the dose. All those inoculations which have been employed until now have been for protection against bubonic plague. Is it not necessary to modify them for pneumonic plague? We have not been told whether vaccines have or have not produced any accidents.

Surgeon-General Uyama then gave a report in regard to his experiences. He had inoculated 1,923 soldiers with vaccine that he had obtained from Professor Kitasato's laboratory in Tokyo. At first 1 cubic centimeter of vaccine was given, and eight days later 2 cubic centimeters were given; in both instances the injection was given in the back. Local and general symptoms followed. The men inoculated perspired a great deal after inoculation, and, in one, swellings of the glands appeared. The temperature rose from three to six hours after the first and second inoculations, and remained high for about forty-eight hours. After the first inoculation it rose as high as 37° C. in 61 per cent

of the cases, 38° C. in 35 per cent, 39° C. in 3 per cent, and above 39° C. in 1 per cent. After the second inoculation the temperature rose to 37° C. in 8 per cent, 38° C. in 30 per cent, 39° C. in 45 per cent, and above 39° C. in 15 per cent. In a few cases it rose to over 40° C., and in 2 per cent of the cases even above 41° C. Most of the soldiers had symptoms of headache, and felt very much weakened, but there were no really serious results. In one case only did they find local swellings for ten days after inoculation. Therefore, he could say that this vaccine gave rather a strong reaction, but was not dangerous to patients.

Dr. KASAI said that he desired also to report upon his experience with inoculation. They had inoculated altogether 2,832 persons, of different nations, namely 1,749 Japanese, 1,075 Chinese, and 8 foreigners. Among these 2,832 persons, 8 developed plague. About these he would like to give fuller details: These cases were all Chinese.

Case.	First inoculation.	Date.	Second inoculation.	Date.	Sickness (date).	Death (date).
	c. c.		*c. c.*			
1	1	Jan. 29	----------	----------	Jan. 31	Feb. 1
2	1	Jan. 29	2	Feb. 5	Feb. 10	Feb. 10
3	1	Jan. 29	2	Feb. 5	Feb. 11	Feb. 11
4	1	Jan. 29	2	Feb. 5	Feb. 10	Feb. 10
5	0.5	Feb. 16	----------	----------	Feb. 16	Feb. 16
6	1	Feb. 6	----------	----------	Feb. 10	Feb. 20[a]
7	1	Jan. 29	2	Feb. 5	Feb. 16	Feb. 21
8	1	Feb. 9	2	Feb. 25	Mar. 5	Mar. 8

[a] Bubonic plague.

Some of these persons were inoculated during the incubation period. The symptoms found after inoculation were as follows:

With symptoms of—	No. of cases.	Percentage.
Fever	926	45.8
Headache	502	24.5
Pains in muscles	402	19.7
Loss of appetite	347	16.9
Lassitude	119	5.8
Pains in joints	60	2.9
Inability to work	439	21.5

The temperature in the cases with fever was between 37°.5 and 40° C.

He could not say anything about the effect of the vaccine, except that, perhaps, in 8 per cent of the cases inoculated which contracted plague the disease was prolonged from its use.

Dr. WORELL said that he had inoculated with Haffkine's prophylactic, prepared in Shanghai, 40 foreign sailors and 40 Chinese. He gave at first 2 cubic centimeters in the upper arm and eight days later the same quantity in the same place. The symptoms were very slight. There was fever in only 10 cases, and the temperature did not rise above 37°.8 C. in them. Pains occurred after eight hours, but disappeared within twenty-four hours. In one case there was an eruption like scarlet fever, but this disappeared within twenty-four hours. In another case there was diarrhœa, but not of a serious nature.

Professor ZABOLOTNY said that he had made inoculations with Haffkine's vaccine at Odessa, in company with Professor Wyssokowitch. They adopted special methods. They gave 1 cubic centimeter of vaccine and 5 to 10 cubic centimeters of antipest serum. Eight or ten days later they gave 2 or 3 cubic centimeters of pure vaccine, and for the third vaccination they gave 3 to 4 cubic centimeters again subcutaneously. The reaction was very pronounced. Fever was often produced reaching as high as 39° C. He could not judge whether the procedure they adopted was very effective, as the circumstances were not similar to those in the recent epidemic. In Harbin the same methods had been used by Dr. Bogucki. The results had not been sufficiently definite to judge whether in this case the methods were really effective or not. In regard to the case of Dr. Marmontoff, he was given an injection with serum and of 2 cubic centimeters of pure vaccine. He arrived at Harbin two weeks after the last injection. Nevertheless he died from plague. Dr. Haffkine and Dr. Bogucki would speak of the results obtained at Harbin. He did not think this method gave sufficient protection against plague pneumonia. Perhaps the mode of preparation of the vaccine must be modified, and they should take a virulent culture from the recent epidemic and study it and, perhaps, an agar culture of this strain. Generally, the question might be said to be still an open one. Perhaps the efficacy depended upon the number of injections. Just now experiments were being made in Harbin with monkeys. They had been infected with plague pneumonia, after having first been inoculated with dead agar cultures, but sufficient statistics had not yet been obtained from which to draw definite conclusions.

Dr. BOGUCKI said that in Harbin 8,685 people were vaccinated. Of these, 2,560 were vaccinated twice with 2.5 or 3 cubic centimeters of vaccine upon each occasion. Among these were 1,600 Chinese, and only 7 of them died of plague.

Dr. HAFFKINE stated that 132 persons had been inoculated by him at the Russian plague hospital at Harbin. Of these, 22 contracted plague, 13 after one injection, 8 after two injections, and 1 after three injections. Of the 13 who contracted plague after one injection, 12 contracted plague after two weeks and 1 after six days.

Of the 8 who fell sick after two injections, 2 contracted plague after six days, 2 after ten days, 2 after fourteen days, 1 after twelve days, and 1 after twenty-seven days.

It could be stated, therefore, that only four persons contracted the disease after the usual period of the negative phase, which was twelve days. In ten cases the patients already had tuberculosis, and in six it was found that infection commenced in an old tuberculous focus. The method used was a combined injection of 1.5 to 2 cubic centimeters of vaccine, and 10 to 20 cubic centimeters of serum. The fever following injection never rose higher than 38°.5 C.

Professor SHIBAYAMA said that in Japan over 100,000 inoculations had been made during the past ten years, but it was very difficult to judge the result, because the epidemics they had had in Japan were neither so virulent nor so extensive as the one that had just occurred. The question of vaccination had been studied during the epidemic of plague in Kobe by Professor Shiga. He gave both vaccine and serum, but in his [the speaker's] experience this gave no better results than the usual method. The reaction was as strong as in the other method of vaccination, and in his opinion it was better to give no serum. The plague toxin was neutralized by the serum, and in his opinion it should not be prevented from producing its full effect on the body.

Dr. FARRAR said that they had heard a great many figures as to the number of persons inoculated during the epidemic, but they had not had a single shred of evidence that any degree of protection had been conferred upon those exposed to plague infection. On the other hand, there appeared to be evidence that persons exposed during the negative phase after inoculation were more, rather than less, susceptible to plague. As regards the Harbin hospital, it would be interesting to know how many of the attendants who died of plague were inoculated and how many were not inoculated.

Dr. HAFFKINE replied that only three persons fell sick, and they had not been injected. Of those inoculated in the hospital none fell sick.

DISCUSSION ON SERUM-THERAPY

Professor SHIBAYAMA. I am unable to speak about serum-therapy in this epidemic, as I have scarcely any data. The serum-therapy of infectious diseases in general gives good results if the serum is used in the beginning of the disease. Therefore, it is clear that the serum-therapy of plague pneumonia generally gives bad results, as on the one hand the disease runs a very virulent, acute, or subacute course, and on the other hand the patients are found in a late stage of the disease and hence the injection is given late. The conditions are analogous to the serum-therapy of diphtheria. If the serum is injected on the first day of the sickness, the mortality is almost nothing, whereas if the injections are made at a later stage a high mortality results. To judge correctly of the value of the serum, one must observe carefully on what day of the sickness the injection was made and the size of the dose.

I should like to speak briefly about the observations in Kobe. Between August, 1905, and December, 1906, we had in Kobe 153 plague cases, among which were 8 cases of plague pneumonia.

Three of these 8 patients died in their homes, and 5 were received in the hospital and treated with serum.

In the first case in the isolation barrack 20 cubic centimeters of plague serum were injected two days before the beginning of the sickness.

With the rise in temperature on the first day 80 cubic centimeters were given, and on the second 160 cubic centimeters (on this day the diagnosis of plague pneumonia was confirmed). Eighty cubic centimeters were given on the third and 80 cubic centimeters on the fourth. The injections were made subcutaneously, a total of 420 cubic centimeters being given. The patient died on the eighth day of sickness.

The second case was that of a coolie who was occupied with the disinfection of plague houses. Immediately after a sudden rise of his temperature 80 cubic centimeters of serum were injected. On the second day 80 cubic centimeters, on the third day 80 cubic centimeters, and on the fourth day 80 cubic centimeters, a total of 320 cubic centimeters were injected subcutaneously. On the sixth day of sickness the temperature fell, and after two weeks the objective symptoms in the right lung disappeared and the plague bacilli disappeared from the sputum.

The third case was that of a doctor in the same plague hospital. He was probably infected during the treatment of an abortion of a female patient. Two days after, moderate fever and cough appeared, and on the next day plague bacilli were evident in his sputum.

He received subcutaneous injections of 80 cubic centimeters on the first day, 80 cubic centimeters on the second day, and 80 cubic centimeters again on the third day, but he died.

The fourth case was that of a woman who was infected while attending a female plague pneumonia patient. Seven days before the beginning of her sickness she received a prophylactic injection of 40 cubic centimeters,

and on the first day of illness 80 cubic centimeters, on the second day 80 cubic centimeters, and on the third day again 80 cubic centimeters, a total of 280 cubic centimeters. On the ninth day the fever and the objective symptoms of the right lung had mostly disappeared. After six weeks she recovered altogether.

The fifth case was received in the hospital on the fifth day of sickness. Immediately after its reception, 80 cubic centimeters were injected subcutaneously, but the patient died after three hours.

Dr. ASPLAND stated that the Chairman desired him to state that the data now being given came within Section D of the programme of epidemiology, *Measures employed to combat the epidemic*. As it was desired that the bacteriological section should be finished this morning, he suggested that these questions should be reserved for their proper places in the programme.

Dr. GRAY said that the discussion so far did not appear to have led to any definite conclusions. The whole subject was a very important one, especially for those who would remain in China after the Delegates had left. Most certainly, if a future epidemic should arise, those present in China would be required to advocate the use of some prophylactic injection. With the object of crystallizing the various *pro's* and *con's* of prophylactic inoculation, he had drawn up the following statement, with the aid of Dr. Petrie and with his and Dr. Farrar's consent and approval.

Dr. FARRAR. No, no.

Dr. GRAY. Then without the approval of Dr. Farrar.

Dr. FARRAR. I do not dissent from it, but I do not think it goes far enough.

Dr. GRAY said that as far as possible his statement was uncontroversory. It was in the form of short paragraphs, and he now proposed to read it to the meeting.

Dr. ASPLAND thought that the reading of this document would prejudice future discussion upon Section D of epidemiology. If Dr. Gray had anything in the form of a resolution, he should remember that they were still in the first part of the programme. He thought the statement that was intended to be read was out of order.

Dr. GRAY said that it was merely a summing up of the points discussed.

Dr. CHRISTIE thought that Dr. Gray ought to be allowed to read it.

Professor GALEOTTI said that he understood that this would close the discussion upon this point.

SOME ASPECTS OF THE QUESTION OF PROPHYLACTIC INOCULATION AGAINST PNEUMONIC PLAGUE

1. It appears that no statistics have as yet shown that any of the vaccines have definitely conferred any degree of protection against pneumonic plague in this epidemic. Those that have been employed have frequently failed to give protection against infection.

2. The statistical evidence points to the conclusion that protection is conferred against bubonic plague by the use of vaccines.

3. Therefore, there are *a priori* grounds for the adoption of inoculation as a means of protection against pneumonic plague.

4. The question, then, is which vaccine would be the best for adoption in future pneumonic epidemics in north China.

5. The following are the vaccines which have been discussed: (*a*) *Strong's attenuated culture;* (*b*) *Lustig and Galeotti's vaccine;* (*c*) *The German Plague Commission vaccine;* (*d*) *Haffkine's prophylactic.*

6. (*a*) *Strong's method.*—This is worthy of careful consideration, but there has not been a sufficiently extended trial to warrant for the present its general adoption as a plague prophylactic in north China. At the same time the results obtained by experiments on animals and on human beings are so striking as to make it important to collect more evidence as to the safety of the method as a practical prophylactic on a large scale.

(*b*) *Lustig and Galeotti's vaccine.*—This preparation is founded on theoretically sound principles and seems to have given excellent results experimentally, but from a practical standpoint regarding its extended use in north China as a prophylactic we would like to have more statistical data as to its value in human plague.

(*c*) *The German Plague Commission vaccine.*—This consists of a killed agar-culture emulsion which has been adopted by the Pasteur Institute. It can be prepared simply and quickly, and has been used extensively in Manchuria and Japan.

(*d*) *Haffkine's prophylactic vaccine.*—This method has been extensively used in many parts of the world for the last twelve years, and there is a general agreement that it confers some degree of protection.

7. It is of paramount importance that the vaccine used should be capable of employment on a very large scale having regard at the same time to the known natural prejudices of the people.

8. These considerations give us reasonable grounds for be-

lieving that the use of killed, plague-bacillary bodies is preferable for the present, if any vaccine is to be employed, without prejudice to the use of the other preparations should they in future be proved to be practicable in China.

Dr. ASPLAND said that in order to make Dr. Gray's resolutions legitimate it would be necessary to withdraw the resolution, passed the preceding day and entered upon the minutes, to refer the whole matter to a committee, which was to report to the Conference.

Dr. STRONG said that in order to close the discussion upon this subsection, he would propose that the Chairman should appoint such a committee, and that this document read by Dr. Gray should be referred to that committee, and then, if there were anything further to be said, the question could be taken up in the epidemiological section. He had nothing further to add to the testimony he had given the preceding day.

Professor ZABOLOTNY seconded this proposal.

The CHAIRMAN said that he would appoint the committee later, so that they could proceed with the morning's business.

Dr. ASPLAND said that he did not think it was for the Chairman to appoint the committee, but for each delegation to nominate one of its members.

Dr. STRONG said that if there were any objection to the Chairman appointing the committee he was quite willing for the Delegates to appoint the committee, if they wished to do so. He suggested that in that case the committee should be nominated in the usual way.

Dr. GRAY seconded this proposal.

Dr. BROQUET proposed that the committee should be formed of a Delegate from each country in which vaccines were made.

This was seconded by Professor ZABOLOTNY.

Dr. FARRAR proposed as an amendment that the committee should be composed of a member of each delegation.

This was seconded by Dr. CHRISTIE.

Dr. FARRAR'S amendment was lost by 5 votes to 3.

Dr. BROQUET'S motion was carried *nem. con.*

Dr. MARTINI pointed out that Dr. Broquet's and Dr. Farrar's proposals really amounted to the same thing, as vaccines were made in all civilized countries.

Dr. BROQUET stated that he had intended his resolution only to include the particular countries referred to in Dr. Gray's document.

This proposal was about to be put to the meeting, when Dr. FARRAR pointed out that Dr. Broquet's resolution in the form that the committee should be composed of a Delegate from each country in which vaccine had been prepared had already been adopted.

Dr. BROQUET thereupon said that he would withdraw his proposal.

The CHAIRMAN then called upon each delegation to nominate a Delegate for the committee.

The following gentlemen were then nominated:

America,	Dr. Teague.
Austria-Hungary,	Dr. Worell.
France,	Dr. Broquet.
Germany,	Dr. Martini.
Great Britain,	Dr. Farrar.
Italy,	Dr. Galeotti.
Japan,	Dr. Shibayama.
Netherlands,	Dr. Hehewerth.
Russia,	Dr. Zabolotny.
China,	Dr. Wu.

DISCUSSION ON SERUM-THERAPY (continued)

Dr. STRONG said that with regard to Dr. Martini's remarks as to the amount of serum necessary to protect rats against plague infection, he concurred with his statements. In 1906 he had performed very extensive experiments with rats to see how much serum would be necessary to protect them against plague infection. He would not go fully into the details of these experiments, but in many of them he had used so much serum that the rats died from carbolic-acid poisoning—i. e., from the carbolic acid in which the serum was preserved, 0.5 per cent. He found that if serum were given at the time of infection, 60 per cent of the animals could be saved; if it were given twenty-four hours afterwards, 40 per cent could be saved; and if given forty-eight hours afterwards, only 33 per cent of the rats were saved. In regard to the treatment of pneumonic plague by serum, he believed that at the time that plague organisms were demonstrable in the sputum it was too late to give the serum with practically any chance of success.

The following paper was read for the author by Dr. KASAI on

PROPHYLACTIC AND THERAPEUTIC PLAGUE-SERUM INJECTIONS AND AGGLUTINATION

By Professor ABE

The plague serum which we used came from Professor Kitasato's Institute for Infectious Diseases at Tokyo. First I would like to make a few remarks about some prophylactic injections which have been performed with this serum. We injected altogether 91 persons with the serum as follows:

Nationality.	Men.	Women.	Children.	Total.
Japanese	59	6		65
Chinese	16	3	1	20
Russian	6			6
Total				91

The quantities of serum used were: Five cubic centimeters with 4 persons, 10 cubic centimeters with 37 persons, 15 cubic centimeters with 18 persons, 20 cubic centimeters with 22 persons, 30 cubic centimeters with 1 person, 40 cubic centimeters with 6 persons, not estimated, with 3; total, 91.

The number of inoculations were as follows: Eighty-two persons were inoculated once, 7 persons were inoculated twice, 1 person was inoculated three times, 1 person was inoculated four times; total, 91.

As a result of these injections, the following symptoms occurred:

Urticaria, 27 cases.
Pains in the joints, 24 cases.
Local muscular pain, 22 cases.
Local swelling, 13 cases.
Headache, 11 cases.
General weakness, 9 cases.
Loss of appetite, 9 cases.
Pains in the loins, 8 cases.
Walking pains, 8 cases.
Swelling of the face, 8 cases.
Neuralgia, 6 cases.
Swelling of the glands, 3 cases.
Vomiting, 2 cases.
Weakness of limbs, 2 cases.
Thirst, 1 case.
Abdominal pain, 1 case.
Diarrhœa, 1 case.
Two days in bed, 3 cases.
Seven days in bed, 5 cases.
More than seven days in bed, no cases.

The temperature of the inoculated was: With 4 patients, over 37° C.; with 10 patients, over 38° C.; with 1 patient over 39° C.; with no patient over 40° C.

With all the others the temperature remained normal.

I would like to enter more into the details of some cases which were observed by us in a village near Liaoyang:

First case.—(*a*) Chinese woman 33 years old. Injection on February 21 with 40 cubic centimeters of serum. Wife of the owner of the Chinese inn of this village who was the first case. She lived in a room with the other seven members of the family who were all infected and died. The woman treated with serum did not die.

Second case.—(*b*) Chinese boy 13 years old. Injection February 21 with 10 cubic centimeters of serum. He was living with his parents and one younger brother in the same house in which the other inhabitants fell sick with plague. The parents of the boy died; he himself and his younger brother remained well. The younger brother refused to be injected.

Third case.—(*c*) First injection on February 11, second on February 19, 40 cubic centimeters on each occasion. Received in our isolation barracks on February 7. On February 11 he was first examined by one of our doctors; the temperature was 37°.4 C., pulse 102. After this he was treated as a plague suspect. The sputum was microscopically examined, with a positive result. His condition remained unchanged until February 19. On this date, on which the second injection of 40 cubic centimeters was given, the *conjunctiva bulbi* became injected; there was coughing, fever, and sputum. A second sputum examination gave a negative result. After this he was released as cured. Two of his relatives who lived with him in the isolation barracks died from plague. From this patient (*c*) some blood serum from a blister was taken at the end of March, about forty

days after his discharge, and the Widal reaction was then positive at a dilution of 1 to 140.

Fourth case.—(*d*) Chinese 68 years old. Injection on February 11, 20 cubic centimeters serum. The wife of this man died from pneumonic plague. He himself remained healthy.

Fifth case.—(*e*) Chinese woman 36 years old. First injection on February 11, 40 cubic centimeters serum; second on February 19, 40 cubic centimeters. Wife of the Chinese mentioned in case (*c*). At the first injection the examining doctor observed injection of the eyes and fever. On February 15, examination of the sputum was positive. Therefore, on February 19, a second injection of 40 cubic centimeters of serum was given, after which the sputum was again examined, and this time with a negative result. The temperature on February 19 was 37°.5 C. It can, therefore, be considered as probable that the first injection was made during the time of incubation, and it is remarkable that in this case the bacilli in the sputum had disappeared about seven days after the first injection. Blood serum was taken as with case (*c*). Positive agglutination occurred at a dilution of 1 to 10 and 1 to 20.

Sixth case.—(*f*) Chinese 20 years old injected with serum, 40 cubic centimeters on February 11. He had lived with two other patients and was, therefore, received in our isolation barrack. He himself remained healthy. The other two died.

Regarding the therapeutic treatment and its result with a few plague patients in Dairen, who were treated under the direction of Dr. Kasayama, I would like to make the following remarks:

First case.—Chinese 33 years old, fell sick on January 26, and a diagnosis of pneumonic plague was made on the same day. He was at once received in our isolation hospital. Four injections of serum were given: On January 26, 40 cubic centimeters; on January 28, 80 cubic centimeters; on January 30, 120 cubic centimeters; and on February 2, 40 cubic centimeters; total quantity, 280 cubic centimeters. After thirteen days bacilli were no longer found in the sputum.

Second case.—Chinese 24 years old. Fell sick on January 26, and was brought the same day into our isolation hospital. Diagnosis on January 27, pneumonic plague.

The first injection was given on January 29 of 120 cubic centimeters; the second injection was given on February 2 of 40 cubic centimeters; the third injection was given on February 3 of 40 cubic centimeters; the fourth injection was given on February 4 of 40 cubic centimeters; total, 240 cubic centimeters.

After thirteen days no more bacilli were present in the sputum.

Third case.—Chinese 40 years old. Received as plague suspect on February 2 in our isolation barracks. On the next day the disease was diagnosed as plague.

The first injection was given on February 2 of 80 cubic centimeters; the second injection was given on February 3 of 80 cubic centimeters; the third injection was given on February 4 of 80 cubic centimeters; total, 240 cubic centimeters.

After seven days the sputum contained no plague bacilli.

AGGLUTINATION WITH THE SERUM OF PLAGUE PATIENTS

A plague strain from Harbin was cultivated on neutral agar and kept in the ice box for six days. The water of condensation was thoroughly mixed with 20 cubic centimeters of salt solution and kept for twenty-four hours in a warm room. As a control we used plague serum from the Institute for Infectious Diseases in Tokyo. The following experiments were performed:

	I. Serum collected on March 5.						
Dilution:	1-10.	1-20.	1-40.	1-80.	1-160.	1-320.	Control.
Patient No. 1	+	+	+	+	—	—	—
Patient No. 2	+	+	+	+	—	—	—
Patient No. 3	+	+	+	+	+	—	—
Plague-immune serum	+	+	+	+	+	±	—

	II. Serum collected on March 5.						
Dilution:	1-10.	1-20.	1-40.	1-80.	1-160.	1-320.	Control.
Patient No. 1	+	+	+	+	+	—	—
Patient No. 2	+	+	+	+	+	±	—
Patient No. 3	+	+	+	+	+	—	—
Plague-immune serum	+	+	+	+	+	+	—

	III. Serum collected on March 12.						
Dilution:	1-10.	1-20.	1-40.	1-80.	1-160.	1-320.	Control.
Patient No. 1	+	+	+	+	+	+	—
Patient No. 2	+	+	+	+	+	±	—
Patient No. 3	+	+	+	+	+	±	—
Plague-immune serum	+	+	+	+	+	+	—

	IV. Serum collected on March 12.						
Dilution:	1-10.	1-20.	1-40.	1-80.	1-160.	1-320.	Control.
Patient No. 1	++	++	++	+	+	+	—
Patient No. 2	+	+	+	+	+	+	—
Patient No. 3	++	++	+	+	++	+	—
Plague-immune serum	++	++	+	+	++	++	—

As we have seen, our experiments all show an agglutination reaction, but it is remarkable that the results with the four cases considered above have never been the same.

After this we cultivated plague bacilli on an alkaline agar medium for forty-eight hours in the incubator at 25° C. One loop was thoroughly mixed with 1 cubic centimeter of sterile salt

solution. The suspension was kept for three hours at 37° C. in the incubator, and used afterward for the following experiments:

V. Serum collected on March 12.

Dilution:	1-10.	1-20.	1-40.	1-80.	1-160.	1-320.	Control.
Patient No. 1	+++	++	++	++	++	++	—
Patient No. 2	+++	+++	++	++	++	+	—
Patient No. 3	++	++	++	++	+	+	—
Plague-immune serum	+++	+++	++	++	++	+	—

VI. Serum collected on March 12.

Dilution:	1-10.	1-20.	1-40.	1-80.	1-160.	1-320.	Control.
Patient No. 1	+++	++	++	++	++	+	—
Patient No. 2	+++	+++	++	++	++	+	—
Patient No. 3	++	++	++	++	+	+	—
Plague-immune serum	+++	+++	+++	++	++	+	—
Serum from a healthy human being	—	—	—	—	—	—	—
Do	—	—	—	—	—	—	—

+++ = Very clearly positive.
++ = Clearly positive.
+ = Positive.
± = Uncertain.
— = Negative.

For comparison we made a number of agglutination experiments with the sera of 28 healthy people, with the result that all were negative at a dilution of 1 to 2 and 1 to 4.

The experiments given above show that we obtained a positive agglutination reaction at a dilution of 1 to 320 with serum of the patients drawn forty days after the beginning of the illness.

Finally, I would like to point out that our plague serum was to a certain degree effective not only as a prophylactic but as a therapeutic agent; therefore, I hope that this serum will come into general use in combating plague.

DISCUSSION

Dr. STRONG asked Dr. Kasai whether it had been stated that in the cases that recovered the serum was given after or before plague bacilli were present in the sputum.

Dr. KASAI said that in one case the patient had no bacilli in the sputum, at the time the serum was given, and was cured. But in two cases the bacilli were already in the sputum, and they were also cured by the serum.

Professor ZABOLOTNY asked if the diagnosis of plague in these cases was made microscopically or by cultures.

Dr. KASAI replied that it was made only microscopically, and that no culture had been made. Although they had made no cultural test, they had tested the serum reaction.

Professor ZABOLOTNY. What was the agglutinating power of the patients' serum and that of the serum used for treatment?

Dr. KASAI said that the tables showed that both were of the same agglutinating power.

Professor ZABOLOTNY asked Dr. Kasai upon what grounds he concluded that these were cases of plague.

Dr. KASAI replied that the diagnosis had been made microscopically and afterwards by serum tests.

Professor SHIBAYAMA said that during one epidemic in Japan there were eight cases of plague pneumonia. Three of these died in their houses, but the last five were treated with Tokyo serum from Professor Kitasato's institute. They were given very large doses. In two of the cases, which were manifestly those of plague pneumonia, they gave the serum in the early stages, and effected a cure.

Dr. MARTINI said that he had had some experience about ten years ago. This was with the case of Dr. Sachs, in Berlin, who died of plague pneumonia. The man who attended Dr. Sachs was immediately given about 45 cubic centimeters of Paris anti-plague serum. Nevertheless he was taken ill, developed fever, and three days later the sputum became bloody. He was given further doses of from 450 to 600 cubic centimeters of serum and was cured. The diagnosis in this case was made by exact bacteriological tests. He had found plague bacilli in the sputum, and had infected guinea pigs and rats in the usual manner. He also made agglutinative tests and everything was positive.

Professor KITASATO said that he had a communication to make upon this subject. He would like to make the following proposal: The families of the plague patients and persons who came in contact with them in this epidemic had succumbed by the hundreds with pneumonic plague in isolation barracks. Therefore, it seemed most necessary to immunize passively, as soon as possible, such persons who are removed to the isolation barracks; this meant that they must all be inoculated with plague serum.

Professor ZABOLOTNY. I agree entirely with you.

Dr. GRAY. Would not the cost of this prove prohibitive? From the point of view of cost, would not this be impracticable?

Dr. BROQUET. The results reported by the Japanese school

and by Dr. Haffkine and the proposition of Dr. Kitasato show that it is necessary that in countries in which plague develops a stock of fresh serum should always be kept on hand, in the same way that cartridges are stored in case of war.

The CHAIRMAN then announced the subject of

MORBID ANATOMY

By Dr. STRONG

The following report is based upon work done in the Mukden Plague Hospital by Dr. Teague and myself.

When one considers that plague is a disease that has occurred in such very large and often protracted epidemics and has been so widely studied, it is rather remarkable, when the original monographs are consulted upon the pathological anatomy of primary pneumonic pest, to find that comparatively few observations have been made upon this subject and that the descriptions in our systems and text-books of pathology and medicine are based upon three cases described by Childe in 1897 and three cases reported by Albrecht and Ghon in 1898, a number far too small to warrant very definite conclusions. The German Plague Commission, in the report of their investigations in India during the same year, described seven cases of pneumonia in plague, but when one reads the description of these it is found that but two were cases of primary pneumonic plague, and in both of them infection was complicated by the presence of other bacteria besides the plague bacillus. Since the publication of these reports, Dürck and Herzog have reported at some length upon the general pathological anatomy of the disease, but neither of these observers had any special opportunity for the study of the primary pneumonic form. During the Japanese epidemic of 1899 to 1900, thirteen cases of primary pneumonic plague occurred, but no autopsies were made. Professor Zabolotny and Dr. Sata have recently each reported upon the pathological anatomy of a single case of pneumonic plague, both cases occurring in physicians. On account of this absence in the literature of observations upon any very extensive material of this nature, a detailed description of the pathological anatomy of the disease as observed during the present epidemic becomes a subject of additional responsibility and importance.

Our observations upon this question are based upon the study of twenty-five complete necropsies performed at the plague hospital at Mukden. All of the material was fresh, many of the necropsies having been performed immediately or within a few hours after death.

External appearance.—The bodies with one exception were those of robust, well-nourished individuals and showed no emaciation. Two of the subjects showed evidences of old syphilitic infection and one had early carcinoma. None of them was tuberculous. The superficial lymphatic glands were not enlarged, and carbuncles, vesicles of the skin, or buboes were not observed. Small punctiform hæmorrhages in the skin about the bends of the elbows and over the chest occurred in two cases and were apparently the result of needling.[1] *Livor mortis* was not as a rule very extensive or marked owing to the freshness of the cases; in three it was extensive over the shoulders and the dependent parts and was of a dark, brownish-red color. *Rigor mortis* in some of the cases had not developed. In others it was very strong. In degree it was, perhaps, when compared with the rigor mortis occurring in other acute infectious diseases, only surpassed by that seen in Asiatic cholera. The muscles were usually of a bright-red color; hæmorrhages were not observed in the abdominal ones, but small extravasations of blood were on one occasion noted in the thoracic muscles in stripping them from the thoracic wall and ribs.

Pericardial cavity, heart and blood vessels.—In the anterior mediastinum in the tissues surrounding the thymus gland usually much œdema and frequently extensive hæmorrhages occurred. On the visceral surface of the pericardial sac, petechiæ often occurred and larger punctiform hæmorrhages were sometimes encountered. On the epicardium varying numbers of petechiæ were observed in most of the cases. The right chambers of the heart were usually distended with blood and in a number of cases showed acute dilatation and thinning of the wall, particularly of the right auricle. The muscle was in some instances soft but usually of a fairly firm consistence. Cloudy swelling was almost invariably noted; early fatty degeneration was observed in a few instances. The bronchial veins sometimes showed hæmorrhages in the intima, and numerous extravasations of blood occurred about the vessels posterior to the peritoneum and in the region of the kidneys, omentum, and mesentery. In the omentum, hæmorrhages were particularly observed in the fat around the larger veins.

Pleuræ.—The parietal pleura covering the thoracic wall, diaphragm, and pericardium in many instances showed numerous ecchymoses in the region of the infected lung, and very often delicate, fibrinous adhesions were observed between the parietal

[1] A method of treatment of the disease employed by certain Chinese physicians of the old school.

and visceral pleuræ. In some instances many of the hæmorrhages were punctiform in character, but in others they were confluent and formed diffuse, larger, dark-red patches.

Lungs.—Fresh, fibrinous pleurisy was observed in every case; in some instances the delicate membrane was reddish, in other cases grayish or grayish-white and could be easily peeled from the surface of the lung. Rarely a gelatinous, œdematous exudate was present. In two instances the pleural cavity contained between 100 and 200 cubic centimeters of blood-stained fluid in which large numbers of plague bacilli were present. Numerous ecchymoses beneath the pleura were almost always encountered, though they varied greatly in extent and in number. In every instance some portion of the lung showed either pneumonic infiltration or engorgement. On cut section of the lung the tissues adjacent to the areas showing pneumonic involvement usually revealed very marked congestion and œdema. On pressure a reddish, serous fluid exuded from the cut surface in great abundance. Sometimes in these areas the œdema gave to the lung tissue a jelly-like consistence. The pneumonic areas were apparently either lobular or lobar in type. In the former, one or several nodules varying from about three to five centimeters in diameter might be found in the lobe. They were usually rather sharply circumscribed from the surrounding lung tissue by a more or less marked ring of engorgement, and were either circular in outline or wedge-shaped. In one instance, on section of the lung, six areas in the stage of early gray hepatization were observed in one lobe situated near the base. Three of these measured 2, 1½, and 1 centimeters in diameter and were all arranged along the same bronchus. About one-half centimeter from the tip of the base of the lobe on the same bronchus were three more hepatized patches measuring 5 or 6 millimeters in diameter. The mucous membrane of the bronchi was dark red in color. The other lobe and the right lung in this case showed only congestion and œdema. Such areas of broncho-pneumonia as just described no longer contained air. On cut section the surface was rather dry, grayish-red in color, and granular in appearance. On pressure mucus plugs were not expressed from the bronchi as is frequently the case in bronchial pneumonia due to infection with other microörganisms. The mucous membrane of the bronchi leading to such areas was bright red in color. Occasionally several pneumonic areas might be arranged along one bronchus somewhat as the flowers of the hydrangea are placed on the stalk of the plant. In the lobar type, which was much more frequently encountered, the whole lobe or a portion of it showed

either only pneumonic engorgement or early red, with beginning gray hepatization. We have not seen an entire lobe in the stage of gray hepatization such as is frequently observed in ordinary croupous pneumonia due to *Diplococcus pneumoniæ*. The patients with primary pneumonic plague evidently die before this stage is reached. However, a smaller area of gray hepatization adjoining one of red hepatization and this in turn shading into an area showing only engorgement was frequently observed. Sometimes death evidently occurred before any apparent hepatization had taken place and only a portion of a lobe showed engorgement. Even in these instances, however, enormous numbers of plague bacilli were present in the lung tissue. In by far the greater number of cases gray hepatization had not been reached. Rarely one lung was practically normal in appearance. However, in these cases in which one lung only showed pneumonic infiltration, the other usually showed congestion and œdema. In other instances single lobes, or all the lobes of one lung, might show pneumonic affection. In some of the cases both types of pneumonia were encountered. In one lung the lobular areas might be observed while in the other the lobar type was present. Or in the same lung a smaller area of gray or red hepatization might be encountered while the remainder or some part of the lobe showed pneumonic infiltration in the stage of engorgement.

The *bronchi* (see Plate I).—The mucous membrane of the bronchi was in every case of a bright-red color which varied in the different instances only in intensity. Often in the bronchi near the bifurcation, the deeper red portions appeared as closely placed, parallel, longitudinal stripes in the bronchial wall. The bronchi contained a red, frothy, bloody serous fluid or more rarely a reddish mucus exudate. The yellow or whitish exudate frequently seen in cases of catarrhal bronchitis or in other forms of pneumonia was never observed. In one case in which the lesions in the lung as well as the changes in the other organs were not very far advanced, the diagnosis of primary lung infection with plague bacilli was suggested from this condition in the bronchi. This diagnosis was confirmed by bacteriological examination.

Pharynx, larynx, and trachea (see Plate II).—The anterior surface of the tongue was usually coated with a brown, buff, or pinkish-gray layer. The papillæ at the base of the tongue and the lymph follicles here and on the posterior wall of the pharynx were swollen. The tonsils were in every instance of about normal size or slightly swollen. On cut section the surface was usually reddish or reddish-gray and in a few instances bluish

in color. In only one case were there small areas of necrosis and hæmorrhages in the tonsil. The mucous membrane of the mouth and throat over the base of the tongue, uvula, tonsils, and adjacent structures was in all cases somewhat swollen and generally appeared of a more or less congested, dark-red color or in a few instances of a reddish-purple hue. From the pharynx to the larynx the mucous membrane as a rule gradually assumed a brighter red color. Over the epiglottis, vocal cords, cartilages, and whole larynx it was generally markedly hyperæmic and red in color, but in a few instances of a whitish-pink or pink hue. When the color was not bright red the injected vessels could be seen more plainly upon the pink background just described. The mucous membrane below the vocal cords in a few cases was not so markedly hyperæmic, but above them, in every instance, it appeared of a bright-red color. Throughout the entire length of the trachea the hyperæmia was always more marked below the vocal cords, whatever the condition above them was. This hyperæmic condition continued in every instance throughout the trachea and bronchi, though it was sometimes less marked in the smaller tubes which led to normal lobes of the lung. In no case was there noticeable œdema of the glottis. In a single instance, in which the epiglottis and surrounding structures showed no injection, the hyperæmia and injection of the vessels did not begin until about 3 centimeters below the cords. In a few cases there were small hæmorrhages measuring several millimeters in diameter in the mucous membrane of the trachea. Over the surface of the trachea a small quantity of blood-stained serous exudate, sometimes frothy in character, was present. There was always much œdema of the tissues surrounding the lower portion of the trachea, and the lymphatic glands in this region were swollen to a greater or less degree. In one instance two of them measured as much as 3 centimeters long by $1\frac{1}{2}$ wide. (See Plate II.) On cut section they were usually red or bluish in color and showed many hæmorrhages. The glands at the bifurcation of the trachea were always greatly swollen, generally anthracotic, and in all instances were of an almost black-red color from resulting hæmorrhages in the glandular substance.

The *œsophagus* was in every instance normal, no hyperæmia of the mucous membrane being observed.

Stomach and intestines.—The mucosa of the stomach was frequently somewhat swollen and showed numerous, small ecchymoses. In a few instances small erosions were present. In a few cases the peritoneal surface of the small intestine was reddened and in a few others hæmorrhages were observed on the

peritoneal surface of both the large and small intestines. These hæmorrhages were of two types—the first dark, almost black in color, measuring from ½ to 1 centimeter in diameter and suggesting in their appearance *œsophagostomum* infection; and the second appearing as fine, bright-red, linear hæmorrhages. The mucous membrane in these cases was reddened and showed a catarrhal condition, with a pinkish mucous layer covering the surface, beneath which were innumerable, bright-red, pin-point-sized areas.

Lymphatic glands.—The bronchial glands near the bifurcation of the trachea always showed more advanced changes than any of the other lymphatics; they were always swollen and almost black in color from resulting hæmorrhages. The lymphatics along the lower portion of the trachea were also usually swollen and sometimes contained hæmorrhages. In a few cases the mesenteric lymphatics showed simple inflammatory swelling, but in the majority of the cases they were normal. The largest ones measured about 2½ centimeters in diameter. On cut section the surface was pink or of a grayish-red or dark-red color, but showed no hæmorrhages or necrotic areas, although in one case in the veins about them the blood had frequently escaped from the vessel walls. In one instance the glands showed small hæmorrhages. In the other lymphatics of the body, no special changes were observed.

Spleen.—The spleen was distinctly enlarged in 56 per cent of the cases. In bubonic plague the percentage with distinct anatomical enlargement of the spleen is considerably higher, but the spleen is by no means always enlarged in bubonic plague, as has frequently been stated. In the present cases it was usually firmer than the typical, infectious splenic tumor, a condition depending upon the increase of red pulp and blood in the organ. On cut section the red pulp was greatly increased and the follicles were usually either small or invisible. In two cases the follicles appeared as white, pin-point areas inclosed by dark-red, pin-head-sized areas, which in turn were surrounded by the lighter red splenic parenchyma. Small, punctiform hæmorrhages occurred beneath the capsule in one instance and scattered through the substance of the spleen in others. The trabeculæ were prominent in only one instance in which the age of the subject was apparently between 50 to 60 years. In one case a reddish-white infarct 4 millimeters in its greatest width was encountered. It was preserved for microscopical section and study.

Kidneys.—Punctiform hæmorrhages measuring several millimeters in diameter were frequently observed in the capsules of

the kidneys, which usually stripped easily from the surfaces of the organs. The kidneys were usually rich in blood, and in a few instances after the removal of the capsule a red, granite-like appearance was observed due to the deeply injected vessels in contrast to the yellowish, fatty parenchyma of the organ. The stellate veins were usually deeply injected. Small hæmorrhages about the surface vessels of the kidneys were unusual, but were observed in three cases. On cut section either parenchymatous or early fatty changes were almost invariably evident. The glomeruli were frequently swollen and often appeared as fine, reddish, pin-point-sized areas. Petechiæ were frequently seen in the pelves and upper portion of the ureters.

Liver.—The liver also invariably showed either cloudy swelling or early fatty degeneration. A few small hæmorrhages about 2 to 3 millimeters in diameter situated beneath the capsule were observed in two cases, in one of which the hæmorrhages were also linear in character, measuring as much as one-half centimeter in length and about 1 or 2 millimeters in width. Small metastatic abscesses such as are occasionally observed in bubonic plague were not encountered in either the liver or the kidney.

The *adrenals* sometimes showed congestion. No pathological changes were observed in the *pancreas, thyroid,* or *thymus gland,* though the tissues about the latter were usually markedly œdematous. In the *uterus,* other *sexual organs,* or *bladder* no special changes were noted.

Bacteriology.—Microscopical preparations and cultures were made from the organs in every case. In each instance the pest bacillus was present in the blood. The bacilli were always much more numerous in the lungs and in the bronchial lymphatic glands at the bifurcation of the trachea than in any of the other organs or in the blood. In the lungs they were found frequently packed together in great masses. They were always more numerous in the spleen than in the blood. In no other disease are such enormous masses of bacteria encountered in the lung. In the tonsil with but one exception the number of plague bacilli found was small, usually not more than was observed in the blood. Staphylococci and streptococci and even Gram-positive bacilli were seen in preparations from the tonsils in several cases. In scrapings from the mucosa of the bronchi, plague bacilli were often abundant, but not always so.

Conclusions.—Epidemic plague pneumonia results from inhalation, the primary point of infection being the bronchi. Through the bronchi the plague bacilli reach the lung tissue and, rapidly multiplying there, produce at first pneumonic changes

of the lobular type, and shortly afterwards more general lobar involvement of the lung tissue. The blood becomes quickly infected, and a true bacteræmia results in every case. Secondary pathological changes occur, particularly in the spleen, bronchial glands, heart, blood vessels, kidneys, and liver. The fact that the bronchial glands at the bifurcation of the trachea are always much more severely affected than any of the other lymphatic glands argues against the theory that epidemic pneumonic plague is primarily a septicæmic disease, and that the lungs are infected secondarily from the blood. Moreover, in the earliest stage of the disease, the blood may be free from plague bacilli. The condition observed in the trachea and bronchi in epidemic pneumonic plague, together with the character of the exudate, is pathognomonic of this condition. From the appearance of the mucous membranes of the throat, larynx, and trachea, a diagnosis of pneumonic plague may sometimes be made. The tonsils may become secondarily infected in pneumonic plague, just as other lymph glands—for example, the bronchial ones—become so infected. However, in pneumonic plague, death occurs before any very marked macroscopic changes occur in the tonsils. There is no doubt also that the tonsils may become primarily infected in epidemics of pneumonic plague, just as has occurred in sporadic cases during epidemics of bubonic plague. This, however, is not the common channel of primary infection, and in such cases involvement of the lymphatic glands of the neck occurs early in the course of the disease. The fact that the œsophagus was found to be normal in every case examined constitutes another argument against the idea of primary, intestinal plague infection, since in many of the pneumonic cases plague bacilli must have been repeatedly swallowed in the bronchial secretions and in the saliva.

There are a few specimens illustrating the special points in the pathological anatomy of plague placed in the windows of the Conference hall. After seeing the extensive material at the Japanese hospital a few days ago, the exhibition of all of our pathological specimens would appear superfluous. In conclusion, I will say that our microscopical studies are not completed and that a full report on this whole subject will be made later. Plates I and II were also exhibited to the Conference.

It was decided at this stage to adjourn until 10 a. m. the following day, but before doing so a resolution, proposed by Dr. FARRAR and seconded by Dr. BROQUET, that after the bacteriological section was concluded the Conference should proceed with the clinical portion of the programme, was carried *nem. con.*

SESSION IX, APRIL 13

PROGRAMME ARRANGED FOR THE DAY

I

C. Bacteriology and Pathology.

5. Morbid anatomy, especially in relation to the mode of infection in plague pneumonia (continued).

II

B. Clinical Data.

1. Types of the disease met with during the past epidemic.
2. Incubation period.
3. Symptoms.
4. Diagnosis.

SUMMARY OF PROCEEDINGS OF THE SESSION.

1. Cases of plague infection among donkeys.
2. The pathologic anatomy of plague pneumonia in Manchuria.
3. Morbid anatomy.
4. Remarks on the pathogenesis of the present epidemic.
5. Discussion on the above four papers.
6. Clinical data.
7. Diagnosis of pneumonic plague in its early stages.
8. Types of the disease and the incubation period.
9. Notes on the incubation period and treatment with serum.
10. Summary of clinical symptoms, etc.

The Chairman (Dr. Wu). Gentlemen, the minutes of Session VIII are before you. You will observe that they are shorter than the usual minutes, because there has been circulated besides a summary of the discussions of the preceding day.

The minutes were confirmed, and Professor Kitasato then took the chair.

The subject of *Morbid anatomy* was then continued.

Dr. Y. S. Wang presented the first paper on cases of plague infection in donkeys.

CASES OF PLAGUE INFECTION AMONG DONKEYS

By Dr. Y. S. Wang

In a miller's compound outside the East Gate, Mukden, a donkey died March 22 with coughing and spitting of blood. Another was taken ill the next day, and then another, until the owner became frightened and removed all of his donkeys, eleven in number, to a place outside the North Gate. By the 28th of

March nine donkeys, besides the first one, had died. Then three of the keepers, who had been in contact with the animals, were reported ill, and were sent to the plague hospital, where their complaint was diagnosed to be pneumonic plague. It was here that the cause of their infection from the donkeys was ascertained. The carcass of one donkey was at once examined, the organs removed, and cultures made from the blood, heart, spleen, lungs, and liver. All showed cultures of plague bacilli.

Besides the three men mentioned above, six others, who had been in quarantine with them, died also, so that the total number of deaths from this single focus was nine men and ten donkeys, twelve men and twelve donkeys apparently having been exposed.

Two of the twelve donkeys were left in quarantine. These have so far shown no signs of disease.

The specimens are in the laboratory, and may be examined.

The CHAIRMAN said that the same subject had been studied by Japanese doctors, who had made post-mortem examinations upon two donkeys[1]; these reports would be presented later on. He then called for the next paper.

THE PATHOLOGIC ANATOMY OF PLAGUE PNEUMONIA IN MANCHURIA

By Dr. AKIRA FUJINAMI

I shall try in the following paper to give a short, provisional report upon the pathological anatomy of plague pneumonia, which I was able to investigate at autopsy during my stay of several weeks in Manchuria with my assistants, Drs. Otsuki, M. Murata, and Narabayashi. Our work is not yet complete; a full report will appear later. Our idea at first was to use for our investigations all the cases which had been sectioned by the Japanese doctors. The material on which my report of to-day is based consists only of twenty-nine necropsies, three of which have been performed on animals. All the cases were fresh, and a few of them had been investigated clinically.

I have no doubt that it will seem strange to you that I am giving here a pathological-anatomical lecture without illustrating it with microscopic preparations. I am sorry to say that a few weeks ago—before I knew that I would have the honor to participate in this Conference—I sent some of these preparations to Japan. I am also unable to bring the remaining part here, as it composes an important portion of the exhibition, which you inspected a few days ago in our hospital.

[1] These donkeys are the same two reported upon by Dr. Fujinami, page 149. For susceptibility of donkeys see footnote page 62 and page 439.—[EDITOR.]

I

1. *Lungs.*—The most prominent changes in most of the cases are shown by the lungs. That we have a true plague pneumonia is established not only from a clinical but also from a pathological-anatomical standpoint. The pathological anatomy of the lungs varies according to the stage of the disease and also according to the manner in which the disease develops. Generally, the lungs are very rich in blood, and appear dark red and more or less œdematous. A pneumonic hepatization, which is peculiar to plague, spreads mostly over the greater part of one lobe, which then appears usually dark red, grayish dark red, or grayish-yellowish red in color; it seldom looks yellowish-gray. The hepatized part of the lung bulges forth, and is harder to the touch, but generally not very compact. The surface of a section is not so granular as in genuine croupous pneumonia. It must be remarked that, besides the extensive hepatization, sometimes single, small, lobular areas of hepatization and infiltration respectively can be recognized.

There are also some cases in which no well-developed areas of localized hepatization can be felt, but in which the whole surface of the lung, on section, looks nearly equally dark red; the complete hepatization in these cases has not yet developed.

The seat of the hepatization is not constant; each lobe can be affected by it. It was noted more often in the right upper lobe and nearly as often in the left upper and lower lobe; also, it was frequent in the right lower lobe; only in one case was the right middle lobe the special seat of a well-marked hepatization. *Microscopically,* the hyperæmia of the blood vessels and capillaries of the lung was very prominent. The alveoli of the hepatized areas contained a great number of leucocytes, besides a serous fluid, red blood cells, and desquamated epithelial cells in variable quantity.

Fibrin threads are rare or almost absent in the contents of the alveoli. The nonhepatized alveoli are either empty or are filled only with œdematous fluid, which sometimes contains a few leucocytes. The plague bacilli accumulate in the alveoli in enormous quantities, and represent a very important constituent in them; they are found not only inside of the hepatized areas but also in places where no inflammatory cellular exudation appears. Especially striking was an extensive accumulation of plague germs in and around the blood vessels and bronchial walls in the lungs and in the perivascular and peribronchial lymph system. Equally striking is the presence of an enormous number of plague germs under the pleura. Single plague bacilli

or small colonies of them can also be seen inside of the blood vessels. Besides the plague bacilli, micrococci, diplococci, and bacilli of different kinds can be found occasionally in the lung tissues.

2. *Pleura.*—In most cases the surface of the pleura is covered with a fibrinous membrane of varying extent; this is particularly marked over the hepatized lung areas. Plague germs can also be found on the surface of the pleura in great quantities. Not infrequently a serous-hæmorrhagic exudate is found in the pleural cavities.

3. *Bronchial, tracheal, and laryngeal mucous membrane.*—Dark red, slightly swollen, covered with a red-colored, foamy, mucus material.

4. *Bronchial lymphatic glands.*—Generally more or less enlarged; in some cases considerably enlarged, in others of normal size or nearly so. Always rich in blood and of a deep dark-red color. The surface appears slightly swollen. The lymph vessels of the lymphatic glands are filled with masses of plague bacilli, whereas they scarcely seem to enter into the follicles. In sections of such lymphatic glands, where an especially large amount of carbon is deposited, bacilli are rarely seen. In addition to the hyperæmic blood vessels, red blood cells, more or less numerous, can be found which have entered the lymph vessels. Sometimes necrosis has occurred with portions of lymphatic glands which contain masses of bacteria.

In certain cases some of the bronchial lymphatic glands show no changes of importance in structure worth mentioning except the presence of masses of bacteria.

5. *Spleen.*—Generally more or less enlarged but usually not to a great degree. The pulp is slightly bulging, generally rich in cells and red blood corpuscles. Under the microscope hæmorrhages can often be seen, but in some of the cases this does not appear clearly. The follicles are usually reduced in size. Plague bacilli are extremely numerous in the pulp. Around the follicles the plague bacilli often show a peripheral gathering, whereas the interior of the follicles is generally free from bacteria, or the organisms are harbored in comparatively small numbers, as in the lymph glands.

6. *Blood.*—In the blood vessels and in the heart the blood is dark red to blackish-red, and generally thick. Bacteria are always found.

7. *Heart.*—In most cases the right atrium and the right ventricle are extensively filled with a blackish-red, thick, nearly half-coagulated blood. Red coagula are somtimes found. The left atrium and the left ventricle also contain blood of the same

quality. The right ventricle shows sometimes a slight dilatation, especially of the conus. The heart muscle appears cloudy. Numerous, fine fat droplets in the muscular fibers are seen in microscopical preparations stained with sudan; the muscle is often fragmented.

8. *Liver and kidneys.*—Hyperæmic, cloudy, and slightly swollen. Bacteria are present in the blood vessels, and are especially plentiful in the liver. The parenchymal cells are seen to contain fat droplets when stained with sudan.

9. *Fauces and pharynx.*—The mucous membrane of the fauces and pharynx is usually dark red and slightly swollen. The dark-red coloring is usually sharply limited at the œsophagus. Only one case showed serous infiltration and hæmorrhage in the submucosa of the fauces. The palate and tonsils are also reddish; they sometimes showed hyperplasia, and sometimes no hyperplasia was present. In most cases plague bacilli were found only in small quantities in the tonsils, and no notable necrosis and hæmorrhage existed. In the case mentioned with serous infiltration and hæmorrhage of the fauces, a great many bacilli were found in the tonsils; also necroses and hæmorrhages were present. The right tonsil was covered with a dirty, grayish-white layer. The papillæ of the tongue were more or less swollen.

10. *Œsophagus.*—The mucous membrane was smooth and rather pale or pale reddish in appearance.

11. *Stomach.*—The mucous membrane was swollen and cloudy looking. In two cases the mucous membrane of the stomach was sprinkled with numerous hæmorrhages from pin-point to pinhead in size, forming erosions or very small ulcers. Two cases of rotund ulcers were encountered. One of these was without doubt of older origin, and must have existed before the attack of plague, whereas in the second case the ulcer looked fresh, but it could not be said to be characteristic of plague or otherwise.

12. *Intestines.*—The mucous membrane is reddened or pale. The follicles were not altered; sometimes they showed hyperplasia. Ulcers were not found. Submucous hæmorrhages occurred rarely (for instance in the colon).

13. *Pancreas.*—No important changes were observed. It was usually reddened and hyperæmic.

14. *Ureter, urinary bladder, sexual organs* with their *adnexa.*—No remarkable anatomical changes were observed, except hæmorrhages, which occurred occasionally.

15. *Adrenals and thyroid gland.*—No remarkable changes were noted; they were usually hyperæmic.

16. *The lymphatic glands.*—Apart from the bronchial lym-

phatic glands, about which I have spoken before, the lymphatic glands in general showed no remarkable enlargement; occasionally, different lymphatic glands (for instance, the mesenteric and mediastinal) showed slight hyperplasia which was not accompanied either by necrosis or by hæmorrhagic lesions. In one case among the patients under observation, several lymphatic glands of the neck were visibly swollen, and the cut surfaces hæmorrhagic.

The lymphatic glands which are situated at a distance from the primary areas of the disease sometimes harbor numerous bacteria in the lymph vessels, but on the other hand such lymphatic glands may not appear abnormal. Murata's case of bubonic plague is distinguished by a swelling the size of a hen's egg of the crural lymphatic glands. The glands show histological changes, consisting of necrosis, hæmorrhages, and infiltration and masses of plague bacilli. The retroperitoneal lymphatic glands were in this case also enlarged, but to a smaller degree.

17. *Brain and spinal cord.*—The central nervous system does not show any extensive, gross anatomic changes. The meninges were hyperæmic and sometimes slightly cloudy and œdematous.

18. Otsuki observed in two cases in the peritoneum a fresh, fibrinous, hæmorrhagic exudation.

19. *Hæmorrhages.*—Besides the hæmorrhages in the severely diseased organs, very often pin-point-sized or larger spotted hæmorrhages could be observed in many parts of the body. More *extensive hæmorrhagic lesions* also occurred generally in the subserosa (peri- and epicardium, pleura, and sometimes in the peritoneum); they occurred more rarely and were smallest in the mucous membranes of the stomach, intestines, œsophagus, urinary bladder, ureter, trachea, palate, etc. Hæmorrhages also occurred in the muscles of the chest, in the retroperitoneal and mediastinal connective tissue, in the tissue between the urinary bladder and the symphysis, in the *vas deferens*, in the *galea aponeurotica*, in the *ligamentum latum*, etc. In one instance a subendocardial, hæmorrhagic lesion was observed on the mitral valve and in the ventricle wall. Multiple, subcutaneous hæmorrhages also occur.

20. *The occurrence of the plague germ in the different organs.*—We have already mentioned that the plague bacilli gather in enormous numbers in the lungs and bronchial lymphatic glands, and, of course, also in the sputum. Sometimes we find them in large quantities in the other lymphatic glands. The masses of plague bacilli are generally largest in the spleen. Bacilli are also very numerous in the blood vessels of the liver.

They are constantly present in the blood, but generally not so profuse in number.

The plague germ can be found in all parts of the body in the blood vessels, even if the organ does not show special anatomic changes. In the kidney, parotid, *hypophysis cerebri,* testicles, and pancreas, the bacteria are usually present in small numbers. The tonsils contain, in most cases, comparatively few bacilli. Few bacilli are found in the urine. They are rather plentiful in the contents of the pleural cavities, and the peritoneal exudate also contains bacilli. Besides this, we found bacilli in the secretion of the nose and the fauces, in the contents of the stomach, in the fæces, in the bonemarrow, etc. In two cases, no bacteria were found in the cerebrospinal fluid. It is very remarkable that we always found the bile free from bacilli in the cases examined.

21. I would like to add a few words about *plague in animals.* We had occasion to make interesting observations in cases of plague in donkeys and dogs.

There were two cases of donkey plague. The first was dissected by Dr. Otsuki at Fushun. One case of plague pneumonia was observed in a dog by Dr. Takimi. In the case of the first donkey, the hepatization was in the right lung, in the other, in the left caudal lobe, and with the dog it was in the left caudal lobe. The pathological-anatomical and histological alterations of the plague lung resemble in principle those observed in the human being.

II

The above-mentioned pathological-anatomical observations justify the conclusion that the infection results mostly from inhalation. It is very striking that the most important and most decided alterations were localized in most cases in the lungs and bronchial lymphatic glands. It shall not be said from this that the plague germs penetrate directly and at once by inhalation into the alveoli. On the contrary, it is to be supposed that the plague bacilli make their invasion at different points of the respiratory channels, occasionally in the higher and highest areas. The manner in which the plague germ gets into the human tissues and is carried from there further, can not yet be stated with certainty. In my opinion, a comparison could be made with the localization of inhaled carbon particles, notwithstanding that these foreign bodies possess quite different properties. The plague germ especially accumulates in the perivascular, peribronchial, and subpleural tissues, where, as is known, the carbon particles are found

in especially large masses. They are also found in the lymphatics of the bronchial lymphatic glands, and this also points the way (by the lymphatics) that the plague bacilli are chiefly spread and increase.

On the other hand, the bacilli enter the blood easily and multiply there; they can be found at autopsy in the blood vessels of nearly all the organs. I could not find proof at our sections that a bacteræmia exists from the beginning of the disease, or that the origin of the pneumonia is traceable to this bacteræmia. In most cases, the principal seat of the disease is the lungs. The observation that the plague germ is so abundant in this organ—inside the alveoli and in the bronchial walls—makes it comprehensible to us why the sputum of the patients is so rich in bacilli. From this it is easy to understand the danger to those who are in contact with patients who are constantly expectorating.

Regarding the pathological-anatomical changes of the lungs, they suggest strongly those of common croupous pneumonia; there is also a certain clinical, unmistakable similarity. The difference between plague and croupous pneumonia (the absence or scarcity of fibrin threads in the alveolar exudate) can certainly be found in the fact that from the beginning the pneumonic germ in our recent cases was the bacillus of plague. It produces a different reaction of the tissues from the pneumococcus. Secondly, the course of the plague pneumonia is always so quick, that a fully developed hepatization or any change toward healing is prevented. The plague organism can increase markedly in the lungs, and before the reactionary changes of inflammation can occur locally, the patient may die. A post-mortem increase of the bacilli in the organs may be possible; a hepatization in consequence of the mixed infection may possibly occur.

All of our cases were not those of primary plague pneumonia.

There are also cases in which the primary affection did not lie in the lungs.

1. Murata's case was, without doubt, one of bubonic plague of the crural glands. These showed a considerable enlargement to about the size of a hen's egg, and on histological examination very extensive changes were found. The invasion of the bacilli into the lungs and bronchial glands was, in this case, surely of a secondary nature, as these organs, notwithstanding that they contained large numbers of bacteria, showed macroscopically no special changes. Clinically, the lung symptoms were totally absent.

2. In a second interesting case, already briefly referred to, the changes of the lung had made no progress, but the lymph

glands of the neck showed a remarkable enlargement with hæmorrhages, and the surrounding tissues of the pharynx and larynx were very much affected. These changes we had not observed in our other cases. In this case it seems most probable that the infection occurred first and especially, perhaps, on the fauces or on the tonsils, and that the lymph glands of the neck received the first infection with plague bacilli, whereas the lung became affected secondarily.

The degenerative changes of the liver, kidney, and muscle of the heart, and the changes in the spleen, are without doubt attributable to the effect of the poison of the plague germ.

Regarding the cause of death, the anatomical changes are in harmony with the clinical features (dyspnœa and in addition marked cardiac affection).

In closing, I wish to express my thanks to President Z. Nakamura, of the South Manchuria Railway Company, from whom I received considerable encouragement in my investigations; I likewise wish to express my obligations to the Chinese officials and to my colleagues, who, through their kind assistance in collecting the material, made my work possible:

Dr. A. Fujinami, professor and prospector of the Imperial Japanese University at Tokyo.

Dr. M. Chuki, prospector of the Kwantung Government Hospital in Port Arthur.

Dr. M. Murata, prospector of the Railway Hospital, Dairen.

Dr. H. Narabayasi, voluntary assistant at the Pathologic Institute of the University of Tokyo.

MORBID ANATOMY

By Dr. KOULECHA

The pathological anatomy of pneumonic plague has been studied very little up to the present time. The reason for this is that in modern times there has been no large epidemic of the disease anywhere except in Manchuria. In the present epidemic, each organ taken from a plague corpse is of great pathological-anatomical interest, and, therefore, it is comprehensible that in the pathological-anatomical study of this material different problems of interest will appear. But I will be satisfied in conveying to you some of my experiences in studying the anatomical material.

I sectioned, in Harbin, twenty-eight plague corpses, and took an interest in studying the modes of infection and in investigating the channels through which the infection enters the human body. It is commonly believed that the infectious material

is inhaled and transmitted by the breath to the lungs. The origin of pneumonic plague is generally explained in this way. It is, of course, very difficult to prove how far the infective matter (whether in the form of small particles of mucus or in dust) is inhaled into the respiratory channels. Does it really reach the lung alveoli or does it remain on the mucous membrane of the respiratory channels? In my opinion, there must be some specially favorable conditions to enable the former to happen. It seems to me, therefore, much more probable that the greater part of the infectious matter is deposited on the mucous membrane of the respiratory channels from which it reaches the lung tissues. From this standpoint, the mucous membrane of the respiratory channels requires special attention, and, being of this opinion, I paid special attention to its condition in dissecting the plague corpses. In examining the first cases, I observed that the mucous membrane which covers the base of the tongue and the follicles which it contains did not look quite normal.

A markedly developed hyperæmia and a considerable increase in the size of the follicles can often be seen. The tonsils are also affected. Their capsules were thickened, and the gland substance was hyperæmic and swollen. Sometimes one is successful in extracting from them pus-like fluid. All this shows us only a catarrhal condition of the glands. If we investigate these organs microscopically, we will find most interesting changes which make clear to us the rôle which the tonsils play in the infection. In the stained preparations one observes the following points: First, we see abundant plague bacilli in the lymphatic vessels, thence they enter into the circulation, and are deposited in the interstitial tissues around the lung alveoli; also, at the same time one can see bacilli in the blood vessels, veins, and arteries. Secondly, one finds such cases where the plague bacilli infiltrate the tissues of the gland diffusely, so that one might speak of a parenchymatous infiltration with bacilli. Thirdly, one can also notice in the gland follicles solid masses of bacilli similar to those seen in buboes. All these changes may be seen in the preparations exhibited, and, therefore, I believe a more detailed description of them is unnecessary.

We find in the tissues an important augmentation of the cellular elements; sometimes, necroses and, at certain points, hæmorrhages. All this proves to us that we have to deal here with an acute, specific angina—that is, that the infectious material which reaches the mouth and the upper respiratory channels affects the tonsils, and penetrates through them into

the lymph and blood vessels; therefore, we can look at these glands in certain cases as being the places of entrance into the body for the plague bacilli. Such a condition is not unknown in the pathology of infectious diseases. For instance, I may mention typhoid fever where also specific angina can be observed and where the infection reaches the blood through the infected glands (according to Dr. Forster and his pupils) in the prodromal stage, and afterwards affects secondarily the bile ducts and the lymphatics of the intestines.

If we examine further the respiratory mucous membrane we find that in the trachea and in the large bronchi it is much reddened and swollen and that the lumina are filled with serous, blood-stained mucous. In one case I even found croupous patches on the mucous membrane of the trachea. At the same time it may be observed that the bronchial glands which contain enormous quantities of plague bacilli are much changed, softened, and greatly congested and the surrounding tissues are œdematous and also congested.

Sometimes we find here genuine buboes among the bronchial glands just as they appear in bubonic plague. Such bronchial buboes are enormously rich in bacilli, as can be easily proved by examination with the microscope.

I observed such changes very often in the glands situated at the bifurcation of the trachea. In observing all this, we can say that the infectious material, which is deposited on the mucous membrane of the bronchi, reaches the surrounding lymphatics and that the lung is secondarily affected. This does not seem astonishing if we observe the great capacity of the plague bacilli to permeate the tissues through the lymph and blood vessels. This is the manner in which I regard the course of the infection. It is evident that in other cases the plague bacilli can reach the lung tissue directly and then are able to produce a primary lung affection. However, on the strength of my own investigations, I concluded that pneumonic plague is not a lobular, catarrhal pneumonia and that it has not a bronchial origin.

From appearances, the pneumonia must be considered as a true lobar pneumonia—that is, a pleural pneumonia—as the pleura is always affected and covered with a fine, fibrinous layer. Therefore, one can classify the plague pneumonia pathologically and anatomically in the same category as croupous pneumonia, to which it is very similar and from which it can be distinguished only by the lack of fibrin in the exudate. The exudate of the alveoli consists of a serous fluid in which a

variable amount of blood and leucocytes are present. According to the amount of red blood cells or leucocytes, which the exudate contains, it is of a more bloody or purulent character.

The desquamation of the epithelium of the alveoli does not exist to a great degree, so that we can not say that the exudate has a catarrhal character. Besides the elements already mentioned, the exudate contains an enormous number of plague bacilli which fill entirely the alveoli, and, when stained with methylene-blue, give the appearance of solid blue masses. There are enormous accumulations of the plague bacilli in the lung tissues, and the organisms are more plentiful than in any other bacterial affections of the lung. It is further interesting to note that this accumulation of plague bacilli is not uniform, but is most marked around the blood vessels. When stained with methylene-blue these vessels appear like thick blue rings.

Therefore, we find in pneumonic plague a bacillary invasion of the perivascular spaces from which the infection appears to spread to the neighboring lung alveoli. Finally, we also see bacilli in the blood and in the lymphatic vessels in such quantities that these vessels may be occluded with plague bacilli.

All the facts we have mentioned show us quite clearly that in the case of pneumonic plague we have to deal with a genuine septicæmic disease. The crowding of the perivascular spaces with bacilli and the condition of the exudate in the alveoli of the lungs, which is principally composed of blood elements, authorizes us to consider the pneumonia as of hæmatogenous origin—that is, that the bacilli and their products pass from the blood vessels into the alveoli of the lung.

Finally, another fact of great interest is the lack of phagocytosis in the cellular exudate in the lung alveoli.

In the microscopic preparations you will find the cell elements and the plague bacilli most intimately mixed, but no phagocytosis is visible. At the same time, considering the morphological condition of the blood as far as can be seen in the lumina of the blood vessels, you will observe quite clearly that a leucocytosis is also absent.

I can not explain these phenomena otherwise than by assuming that through the enormous flooding of the whole organism with plague bacilli an enormous production of toxin is the result, and that the toxin paralyzes all the apparatus of defense of the body. Utterly unarmed, the infected human body succumbs in a few days. The morphological condition of the blood has been studied by my colleagues, Drs. Zlatogoroff and Padlevsky. These gentlemen may, perhaps, give you some further information on the subject.

Conclusions.—1. Pneumonic plague is a septicæmic disease in which a decided overflooding with bacilli of the blood and of the lymphatic system can be observed.

2. The infectious material can enter from the mouth, through the specific affection of the tonsillar glands, the blood, and lymphatic vessels. Further, it is possible for the plague bacilli to reach from the mucous membrane of the trachea and bronchi to the neighboring lymphatic glands and from there into the blood. The lungs, it appears, are affected secondarily by way of the blood circulation. The great accumulation of the plague bacilli in the perivascular spaces also points to this conclusion.

3. Pneumonic plague is a lobar pleuropneumonia of hæmatogenous origin, and should be classified in the same category with croupous pneumonia.

REMARKS ON THE PATHOGENESIS OF THE PRESENT EPIDEMIC IN NORTHEASTERN CHINA

By Dr. MARTINI

In the following remarks I would like to show how, in full accordance with my experiments previously published, both the assumed modes of infection, (1) by inhalation and (2) by infection by means of the lymphatic system, can be accepted as proved in the present epidemic of plague pneumonia.

As mentioned in one of the former sessions in these experiments concerning plague pneumonia, I introduced by inhalation from lung to lung in different species of animals susceptible to plague a not very virulent strain of the bacillus of bubonic plague. I made them inhale it in a natural way, first, by spraying the spleen juice of a plague-infected white rat, and then by spraying cultures of plague pneumonia bacilli or fluid from the plague pneumonic lung suspended in a physiological salt solution.

In the first experiment, with the spleen juice, two out of four white rats died from plague pneumonia after two, and one after three days; the last was killed on the eighth day; fresh plague pneumonic lesions were found in the post-mortem examination.

The following experiments were made with plague pneumonia cultures of this strain, or with fluid from the plague pneumonic lung, both materials showing no difference in their effect.

There was also not much difference in the usual interval between the day of inhalation and the day of death. The animals I speak of, white rats, died from three to five days after inhalation. This was the case in the first of the experiments of the latter series, and also in the following eight experiments with this strain. But there were two other strains of bubonic plague from different epidemics with which I experimented. These

could be brought to a higher degree of virulence by inhalation and infection of the lungs, killing all the animals within two days after some passages through the lungs.

On the other hand, when I compared the virulence and toxicity of the first original strain not influenced by lung passages—by means of the subcutaneous and intraperitoneal infection—with that of the same strain but taken from the last lung passage, I saw a very remarkable difference:

(1) White rats, subcutaneously infected with agar culture of the original strain, or with plague spleen juice, died in seventy-two hours; but white rats, infected in the same manner with plague pneumonia juice of the last lung passage, died in thirty to thirty-six hours. Both series showed buboes and bacteræmia.

(2) White rats, intraperitoneally infected with plague peritoneal exudate of the same original strain, died in twenty-four hours, but white rats, infected in the same manner by plague pneumonia juice of the last lung passages of this strain, died in from six to nine hours by plague bacteræmia (determined carefully bacteriologically) and, of course, without any buboes.

These examples, therefore, show that it is possible to obtain a very high degree of virulence and toxicity by means of lung passages.

If we compare the results of these experiments with the experiences encountered in the present epidemic of plague pneumonia among human beings, we find a reasonable explanation of the two types of plague there observed:

(1) We have heard from Drs. Zabolotny, Strong, and Fujinami about real plague pneumonia cases—as far as observations exist—followed often by a final bacteræmia, without any complication with plague from feeding—i. e., without visible lesions and alterations in the mouth, fauces, pharynx, and larynx. These seem to represent a so-called primary form of inhalation pneumonia, like that mentioned above in the animal experiments.

(2) We have heard from the same authorities, and it has been fully explained by Drs. Koulecha and Padlevsky, that definite cases of bacteræmia have been observed, resulting from lesions of the tonsils and from other parts of the uppermost intestinal and respiratory channels, which killed most patients of this type by a combination of bacteræmia and pneumonia, and a few by bacteræmia alone. This seems entirely credible, according to our experiments on the virulence and toxicity produced by passages through the lungs in animals, especially of white rats, and infection by the subcutaneous and intraperitoneal methods. The last mode of infection with a lung-passage strain kills these

animals very much quicker than it does those infected with the above-mentioned original strain of bubonic plague if not passed through the lungs.

We believe, therefore, as in the corresponding human cases of plague bacteræmia, during the last epidemic of plague pneumonia, that the germ becomes gradually so highly virulent by the natural passages through the lungs that, if it meets susceptible, perhaps slightly injured, areas in the uppermost intestinal and respiratory channels, it can there infect the body with a very rapid, fatal plague bacteræmia, sometimes, but not always, combined with or followed by a plague pneumonia, while maxillary buboes generally can not be developed in the short interval of a few days between the beginning of the infection and death.

I, therefore, conclude that my inhalation experiments with animals seem to give some elucidation to the pathology of the present epidemic of plague pneumonia in northeastern China.

DISCUSSION ON DR. KOULECHA'S PAPER ON MORBID ANATOMY

Professor FUJINAMI said that he had somewhat the same views. Nevertheless, it was very difficult to say what was the real manner in which the development of the disease took place. It was certain that infection could start in the mouth, but it could also start from the trachea and the large bronchi. Masses of bacilli found in the perivascular tissues were also introduced by the lymphatic vessels. The bronchial glands often had the appearance of containing accumulations of carbonaceous matter. He had made microscopical slides from different organs, and always had found more bacilli in the bronchial glands than in the tonsils, where there were few. He believed that primary plague pneumonia actually occurred, and then the most marked alterations were encountered in the lungs and in the bronchial system.

Dr. STRONG. Although we have agreed not to discuss Dr. Koulecha's paper until the whole subject of morbid anatomy is reached, I should like to ask Dr. Koulecha before he leaves whether, in his primary tonsillar cases, the epithelium was greatly eroded; whether there was macroscopical evidence of infection; whether, in some of these cases, he did not find other microorganisms, such as streptococci, staphylococci, or diplococci, or Gram-positive bacilli present, and whether he does not feel that these organisms might not, at least sometimes, play a rôle in the tonsillar affections in septicæmic plague cases, even in those cases in which there were small numbers of plague bacilli in the tonsils. Albrecht and Ghon have laid especial stress upon tonsillar infection in sporadic cases of the secondary pneumonic

type; in these cases a very marked œdema of the glottis was usually present. In fact, many of their cases died of œdema of the glottis. Have you found places in your tonsillar cases where erosion of the surface of the gland has occurred where the epithelial cells are absent in fact? I shall speak fully of the condition of the tonsils observed at our autopsies when the subject comes up later. [See pp. 138 and 141.]

Dr. KOULECHA said that he would answer Dr. Fujinami first. He felt that infection from the mucous membranes into the glands was not the only possible mode of infection. That from his observations it appeared that infection started in the mouth through the mucous membranes and through the tonsils and other places. The bacilli had to travel a very long way to reach the lungs from the mouth, and thus would lodge, on the way, in the mucous membranes of the mouth, trachea, and large bronchi. It did not seem very probable that they passed through the mouth, nose, trachea, and bronchi, and finally lodged in the alveoli. In reply to Dr. Strong, he would say that in one of the slides which he had placed under the microscope in the Conference room, microscopical loss of the epithelium could be seen. As regards mixed infections in the membranes, one found nearly pure cultures, but in the nodules of the tonsils one might find many different bacilli. Plague bacilli had been found only in the living tissue and not in any necrotic areas. From this living tissue the organisms entered into the blood. He had used Gram's stain, and found in the tissues only Gram-negative organisms. It could only be ascertained by sections if the tonsils were normal or not.

Dr. BROQUET said that Yersin demonstrated that other microbes were unfavorable for the development of pest bacilli and that the pest bacillus could not be cultivated if it was put in proximity to other species of bacilli. He did not believe that if infection were provoked by streptococci and staphylococci the plague bacillus could penetrate the tissues through this primary infection. Probably, if one could provoke in sick people mild infection by the use of other microbes it would greatly hinder the development of plague infection.

Dr. ASPLAND suggested that discussion upon this paper was out of order at the time and should now close and that it should be continued when the whole subject was again considered at a later session.[1]

Dr. FARRAR seconded this proposal. He thought that sufficient discussion had taken place upon this paper and that it should

[1] See resolutions of Conference, Session III, page 40, and Session IV, page 58.

now be closed until the Delegates came to deal with the subject of morbid anatomy in due course. He therefore suggested that they should proceed with the rest of the day's programme.

Dr. Strong moved that Professor Zabolotny should be allowed to speak upon this paper before the discussion was closed for the present.

This was agreed to.

Professor Zabolotny said that Dr. Koulecha preferred to believe that in these cases hæmatogenous infection was the rule. He (the speaker) thought that that remained to be proved. It was a matter that must be proved statistically, and, up to the present, the statistics were not sufficiently large for them to decide this question definitely. It was necessary to ascertain how many cases were of hæmatogenous and how many of direct pneumonic origin. He agreed with Dr. Fujinami in regard to the question of carbonaceous penetration of the peribronchial glands. He had seen pneumonic cases in Glasgow where the bronchial glands were quite black. He thought that the bacilli could get into the trachea and bronchi and stream slowly with the mucus until they reached the alveoli and lodged there. More post-mortem examinations were desirable to settle this question. He might remark that in the first stage of plague pneumonia there were no bacilli in the blood.

Dr. Aspland moved and Dr. Farrar seconded a proposal that the paper of Dr. Koulecha and the subsequent discussion upon it should not be included in the minutes of this session [this refers to Session IV, p. 58], but take its place in correct order in the discussion with which it was connected.

This motion was carried. [The paper, therefore, has been inserted in the proceedings of this session (IX) in accordance with the resolution.]

DISCUSSION OF DR. STRONG'S AND DR. FUJINAMI'S PAPERS ON MORBID ANATOMY

Dr. Strong. I think the Conference is to be congratulated both upon having this opportunity of hearing the very interesting paper by Dr. Fujinami and upon the fact that he has had the opportunity of making these investigations. His reputation as a pathologist is so well known that I need not speak of it. It is a source of great satisfaction to us to have Dr. Fujinami confirm, in almost every detail, our work upon the pathological anatomy of this disease. I should like to ask him whether in any of his cases he observed tuberculous infection. In this section yesterday it was suggested that individuals with tuberculosis might be more susceptible to plague infection. This

point was brought up in connection with the question of prophylactic inoculations. In none of the cases examined by us were active lesions of tuberculosis present. It is, I think, important to have data upon this point from all who have made autopsies during the present epidemic.

Dr. Fujinami said that he had intended to speak about this question during the day. He had observed only a few cases in which tubercular infection had been found in the lymphatic glands and only one case in which it was found in the lungs. He could not say that he believed in any special susceptibility of tuberculous people to plague, and he could not say that he considered the matter fully settled, because his own observations had been too few in number. He could say, however, that in the tuberculous areas he found very few bacteria, and he believed that this made it clear that it was because the invasion of the lymphatic system of these patients had been interfered with. He did not believe that there was such open communication for invasion in these cases. In conclusion, he desired to know in how many cases Dr. Strong had found plague combined with other diseases.

Dr. Strong said that he had found two cases with old syphilitic infection and one with early carcinomatous glands.

Dr. Kasai stated that in his hospital he had seen one case of plague combined with tuberculosis and it had recovered.

Dr. Fujinami said that Dr. Strong had referred the preceding day to the name of Dr. Sata and his report about a case of a physician who had died of plague pneumonia. In that case the right lower lobe of the lung was found to be infected with plague pneumonia, and also the bronchi, pharynx, and glands. It was a case of mixed infection, diplococci being found in the lungs.

Dr. Haffkine said that in three cases of pneumonic plague he had found old calcified glands and in ten cases examined clinically, tuberculosis, combined with plague.

Professor Zabolotny stated that in the case of Dr. Wesnikowitch they had found an old pleuritis in one lung. This lung was not attacked by plague, but the other one was infected. In the case of Dr. Marmontoff and another case there was tuberculosis of the lung in addition to the plague infection.

Dr. Gray thought it would be rather remarkable if there were no tubercular complications with pneumonic-plague cases, because it was well known among medical practitioners that tuberculosis ravaged this land. He had seen reports from south and from north China, and in all medical reports in stations in which there were foreign doctors they agreed that tuberculosis was one of the most prevalent diseases. It would therefore be

very remarkable if no cases of tuberculosis were found among the plague patients.

Dr. STRONG said that in the light of what Dr. Gray had said it was surprising that so little tuberculosis had been found at autopsy in pneumonic-plague cases. The plague infection, in most cases, appeared to have occurred in very healthy individuals. The percentage of those suffering from tuberculosis was very low. Dr. Haffkine had spoken about cases of calcified glands, but such lesions, of course, would probably exercise little or no influence over the susceptibility of the patients at the time when they contracted plague. He only reported ten cases in which he had found tuberculosis clinically. From what Dr. Gray had said, this small amount of tuberculous infection seemed very remarkable.

Dr. ASPLAND stated that out of about 260 deaths in Fuchiatien, four cases were reported in which tuberculosis had existed for possibly eight or nine months before plague developed.

Dr. WU thought that Dr. Martini's paper had cleared up some apparent difficulties in the understanding of the abnormal virulence of this epidemic. He believed that he was not wrong in saying that Dr. Martini stated that he had started with bubonic strains, and then produced pneumonia in rats, and that the virulence increased as it passed from rat to rat. He (Dr. WU) did not know whether that agreed with Dr. Strong's idea that he had found in most cases that the bacilli in this epidemic were not more virulent than the usual bacilli from bubonic epidemics. He thought it would be very interesting, if he might make the suggestion, to perform more experiments with animals, such as rats, and especially with mules and pigs. In regard to these experiments, might he suggest that some experiments be made with regard to natural infection—that was to say, that an infected animal should be placed with a noninfected animal—and that the symptoms of pneumonic plague should be specially looked for, such as expectorating of blood, coughing, etc., to see whether they were the same as in human beings and as in those animals at Harbin, about which reports had been made.

Dr. PETRIE said that Dr. Wu's point was a very good one. He desired to ask Dr. Martini whether the bubonic strains he had used in his experiments were fresh from bubonic cases or were subcultivated in the laboratory. That might explain the apparent contradiction between his results and Dr. Strong's ideas upon virulence.

Dr. MARTINI said that he used cultures from agar media. These had been a long time in the laboratory. He made these experiments only to show that the strain could be made more

virulent. Apparently his paper had been misunderstood, as he thought his ideas were not at variance with those of Dr. Strong. He had given only an explanation of the occurrence of two types of infection in this epidemic, caused by the same germ: (1) Primary plague pneumonia and (2) bacteræmia, with or without involvement of the lungs.

His paper dealt only with the pathogenesis of these types, and not at all with the epidemiological aspect of plague pneumonia or with the different virulence of the strain.

Dr. Strong said that in reply to Dr. Wu's question whether his ideas were at variance with those of Dr. Martini in regard to the virulence of the organism during this epidemic, he thought the testimony he had given on the subject of virulence would show that they were not. He had particularly stated that he believed that the organism, during this epidemic, attained maximum virulence, and that he considered that the reason that it had maintained this constant high virulence was because of its passage direct from man to man—perhaps, one might say, from lung to lung. This, he believed, was in accordance with the experiments performed by Dr. Martini. He had also stated fully that this organism was not more virulent than some bubonic strains. Some strains of bubonic plague had shown the same maximum virulence that had been exhibited by the strains isolated in this epidemic. These statements were based upon actual experiments. Professor Shibayama's experiments, and his own, bore this out. They could be repeated and verified easily.

Professor Zabolotny stated that he had obtained from Bombay some very virulent cultures and some nearly avirulent cultures. The Austrian Commission had confirmed this. There were in each epidemic different strains, some virulent, and some avirulent, but he thought that generally the culture in the present epidemic was a very virulent one, perhaps more so even than that of bubonic plague.

Professor Shibayama stated that the plague bacilli of bubonic plague could be quite as virulent as the strains in the recent epidemic, so that he did not think the character of the epidemic could be explained by virulence alone. He thought it might depend, to a large extent, upon overcrowding of the people in inns and other places.

Professor Zabolotny asked Dr. Fujinami whether he had made any observations in regard to mixed infections. He thought that some of the alterations in the lungs depended upon these mixed infections—with pneumococci, perhaps.

Dr. Fujinami agreed that it was quite possible that mixed

infections had something to do with this point. In one case, in which the middle lobe was infected, he had found many streptococci, perhaps other bacilli, and only a few plague bacilli. The hepatization was more of a yellowish-gray color. In this case he had found very few bacilli in the spleen. His observations upon this subject were not yet finished.

Professor KITASATO. I am now closing the section upon bacteriology. I thank all my esteemed colleagues who have delivered such interesting and valuable lectures and discussions.

Dr. WU. Before Professor Kitasato vacates the chair, may I express to him, upon behalf of the Delegates, the great pleasure he has given us by his presence here. His great name is well known to us, and we all admire his experience. He has graced the proceedings of the Conference by accepting the post of Chairman of this section, and I am sure he will carry away with him memories of the pleasant time he has had here. We all hope that he will be able to stay as long as our proceedings last.

Dr. FARRAR said he would like to point out that the Conference had not quite finished the bacteriological section, because sections 1 f and g of the programme had not been completed, and would have to come on later.

Dr. WU took the chair.

The CHAIRMAN announced that they would now discuss Section B, *Clinical data.* He called upon Dr. Christie to read his paper upon this subject.

CLINICAL DATA

By Dr. CHRISTIE

These notes are far from complete. The fact is that in this epidemic we were so busy establishing and carrying out measures for protecting the people that there was no time to make careful clinical observations.

The clinical types of plague met with in this epidemic are:

1. Primary pneumonic.
2. Septicæmic.
3. A few cases of bubonic and so called "abdominal" have also been reported.

The epidemic, however, may be said to be of the pneumonic type, and the following clinical features have been noted:

Age.—There is notable immunity among the very old and very young. In not a few instances whole homes have been carried away with the exception of an aged grandparent and one or two infants.

Sex.—Returns show the proportion of males to females affected to be 8 to 1. The reason for this may be that there is a preponderance of men in the population of the cities, and that men move about more, and come more in contact with the disease.

Occupation.—At an early stage in Mukden, before the inspec-

tion of traffic began, a large number of rickshaw coolies and some carters contracted the disease, doubtless by carrying passengers from the railway stations. The mortality has been specially heavy among coolies who congregate in the labor market and sleep in overcrowded, dirty inns.

Predisposition and immunity.—It is said that opium smokers are less susceptible, but this needs proof. The matter, however, is worthy of investigation. A few cases are recorded where individuals have been exposed to overwhelming infection without contracting the disease. There is the instance of the well-known native doctor in Harbin whose patients all died while he remained unscathed. Also there was a woman in Kaiyuan who nursed four plague cases and apparently conveyed plague to three other people, without herself contracting it.

Incubation.—The incubation period varies from one to seven days. The average has been three to five days.

Symptoms.—The disease generally sets in with a chill, headache, pain in the limbs and back, and sometimes nausea and vomiting. The temperature ranges from 100° to 102° F., but seldom rises above 103°.

Respiratory system.—Respirations are increased, being 30 to 40 and sometimes 50 a minute, accompanied by a feeling of pain and oppression over the chest or on one side. Some hours after the commencement of the attack, a cough develops, which at first is short and dry, but soon there is a little expectoration. At first the sputum is gray or yellowish; in an hour or two streaks of blood appear. In one instance, after use of Yersin's serum, the sputum remained viscid and frothy with red streaks throughout. However, in most cases it becomes a watery red, sometimes consisting of pure blood and coming from the nose as well as from the mouth.

The physical signs are frequently obscure or absent in the early stages. In the later, moist sounds and bronchitic râles are heard, and there are often areas of dullness.

Circulatory system.—The pulse is usually full and bounding, rate 88 to 100, and the face is flushed in the earlier stages, but the heart gets steadily weaker, and toward the end there is distinct evidence of cardiac failure.

Alimentary system.—The tongue soon becomes coated, whitish in the center, and red at the edges. Later it becomes dry. In some cases there is nausea and vomiting. Constipation is common, and tenderness over the abdomen has been complained of. Diarrhœa has been a prominent symptom in some cases.

Urinary system.—The urine is high colored and scanty. It is said sometimes to contain blood.

Cutaneous system.—The skin is at first hot and dry, and, although it becomes moist later, profuse perspiration seems to be uncommon.

The color of the face at first is flushed, but soon becomes grayish, then dark yellow, and is latterly of a dark, leaden hue. This is, perhaps, one of the most characteristic and invariable features of the disease.

Nervous system.—The patient has frequently at first a look of apathy, drowsiness, or anxiety, associated with severe headache. In some cases the disease sets in with something like a paralytic seizure, the patient suddenly falling down, and, if able to rise, he has a staggering gait and incoördination of speech. The mental faculties are frequently not affected until near the end, when there is low, muttering delirium. Sometimes the delirium is active, the patient getting out of bed and trying to escape. Coma sets in as death approaches.

Diagnosis.—The diagnosis of primary pneumonic plague in the early stages presents great difficulties. There can be no certainty until the sputum appears, and even then the possibility of other forms of pneumonia or of tuberculosis must be kept in mind. The sputum, however, is quite different from the rusty sputum of croupous pneumonia. Bacteriological examination of the sputum should be made as early as possible, as this alone forms a sure diagnostic basis.

Prognosis.—There has been no case of recovery in Mukden, but a few recoveries have been reported from other places.

Treatment.—In treating pneumonic plague, no drug appears to be of much value. But this epidemic has been too sudden, the course of the disease too rapid, and the number of medical men available too small for it to be possible to carry out satisfactorily any line of therapeutic investigation. There has not been sufficient opportunity to establish the value of Haffkine's prophylactic or of Yersin's serum, but it seems to me that our only hope lies in this line of treatment.

Other types of plague.—Several abdominal or intestinal cases have been recorded. One which took place at the Mukden Railway Station I shall report in full.

The patient was a railway employee, aged 42, of respectable family. On the 17th of the first moon [February 15] he came into the city to see the sights. He had some food in an eating house, and returned to the station the same night. He had good health until the morning of the 20th, when, at 8 a. m., he had slight pain in the abdomen and diarrhœa. During the forenoon he had five movements, without any blood. He complained

of little or no discomfort. In the afternoon the diarrhœa continued and blood was passed. Suddenly he became weaker, and his mother, who attended him, said his color grew bad. There was no cough nor sputum, but he complained of feeling cold. Up to midnight, he had in all nine movements, the last four containing blood. At that time he was collapsed and lay still. At 3 a. m. he was comatose, and the color of his face was very dark. At 4 a. m. he threw up his hands over his head and expired. This was on the 21st, after twenty hours' illness.

There were two rooms in the house and eight inmates, but only the mother came in contact with the patient. She gave him food and drink, and handled him a good deal.

On the same day, the 21st, the house was emptied, as the case was suspicious. The seven inmates were put in a house near the station, and kept completely isolated; all were then in good health.

On the afternoon of the 24th, three days afterwards, the mother (aged 69) fell suddenly ill with coughing, and later on was expectorating blood. She was removed to the plague hospital and died there on the 27th, the case being certified as plague by bacteriologic examination.

A sister of the first case attended to the mother until her removal. She developed pneumonic plague on the fourth day after contact with the mother, and died on the 29th.

Neither of these women had any other possible source of infection except as stated.

Both abdominal and bubonic cases have also been reported from Kirin.

About 10 per cent of all cases in this epidemic seem to have been what is called septicæmic—that is to say, without any pneumonic manifestation. The attack is sudden and death rapid; nervous symptoms are prominent; there is giddiness and staggering, the patient often falling by the roadside; great prostration is also present, and the patient soon passes into a comatose condition. The face after death is very dark. Few of this type of the disease have died in plague hospitals, as the course of the disease is too rapid.

The following paper was then read on the

DIAGNOSIS OF PNEUMONIC PLAGUE IN ITS EARLY STAGES

By Dr. Ch'uan Shao Ching

The diagnosis of pneumonic plague in the early stages is often most difficult, especially when no symptoms have appeared other than moderate fever (102° F.) and a rapid pulse.

In any extensive epidemic like the last, each of the following symptoms is suggestive, namely:

1. An anxious expression, feeling of lassitude, and headache.
2. Tightness in the epigastrium or side of the chest, especially when accompanied by dyspnœa of 30 to 40 respirations.
3. Sudden fever varying between 102° to 103° F., which shows no tendency to fall even with large doses of antipyretics.
4. Rapid, soft, and fluttering pulse, at first 100–110 a minute, but later increasing rapidly.

Vomiting sometimes, but not often, occurs. An initial rigor is usually absent.

The usual features observed are:

General appearance, ill, eyes often slightly congested. Tongue, at first coated with a thick brownish fur, but as the disease progresses this coating disappears, giving rise to the characteristic red, swollen, congested, glazed tongue. Respiratory system, discomfort in the epigastrium or lateral portions of the chest, followed always by dyspnœa and often by excruciating pain over the ribs.

On palpation some loss of expansion is observed.

On percussion very often no loss of resonance is evident, the characteristic dullness of croupous pneumonia being absent, even in the later stages of the disease. In the early stages this absence of changes in percussion may easily deceive one as to the gravity of the disease.

On auscultation at first apparently nothing abnormal is observed. There are no râles or tubular breathing. However, at the bases, some diminution of air entry, accompanied by a few moist sounds, may usually be observed even at the beginning of the disease. These changes, however, are not invariably present. When the disease is well developed râles make their appearance, but they are seldom well marked. The apices of the lungs are usually free.

The heart shows a slight dilatation on the left side, and deep cardiac dullness reaches one-half finger breadth outside the left nipple line. As the disease develops and the dyspnœa increases the right side is also dilated and signs of cardiac distress begin to appear.

The nervous system shows no marked changes in the early stages, but headache and pain in the bones are often marked at this time. In the late stages of the disease delirium and coma are common.

The urinary system shows nothing characteristic in the early stages of the disease. In the late stages albuminuria is common.

To summarize: Before cough appears and when bacilli can not be found in the sputum or blood, the principal means for diagnosis lie in the sudden onset of the symptoms, the peculiar character of the pulse, the severe headache, and the absence, usually, of marked physical signs in the lungs.

While in Harbin we had two cases of lobar pneumonia which were sent to the suspect hospital. These patients complained of cough, and also had bloody sputum early in the disease. The bacteriological examination showed the pneumococcus, while the lung symptoms were marked from the very beginning.

A few cases of diarrhœa with bloody stools were noticed at the plague hospital, but these symptoms were mostly regarded as secondary, and the patients did not survive more than twenty hours after the appearance of bloody stools.

Later on in the epidemic there was an old man admitted to the inspection hospital for slight fever (100° to 102° F.) and some delirium. There was no cough and no sputum. Bacteriological examination revealed no bacilli in the throat or in the blood. The patient died after three days. He had lost both sons from plague, and this affliction had probably disturbed his mental equilibrium. Spleen puncture showed no bacilli.

We saw no typhoid-like or continued fever in the cases under our notice.

In conclusion, I would state that the bacteriological diagnosis is by far the most important and reliable, but, in the absence of sputum or blood examinations and with no suitable apparatus for agglutination experiments, we often relied upon the symptoms mentioned above in making a diagnosis before the characteristic signs developed.

The next paper was upon

TYPES OF THE DISEASE AND THE INCUBATION PERIOD OBSERVED IN EIGHTEEN CENTERS

By Dr. HILL

The replies from the great majority of the eighteen centers to which questions were sent state that only pneumonic cases were seen, but three of four observers estimate nonpneumonic cases at about 5 per cent.

From one place fifteen cases with buboes are reported, "particulars consistent with infection by parasites from a human case being given," but there is no conclusive evidence of the nature of these cases; the clinical facts, though not easy to explain, are not altogether in accord with the usual features of bubonic plague.

One abdominal case is reported from Chefoo, but no particulars are given.

The answer to the question whether there had been observed any illness, among contacts or attendants, suggestive of a mild attack with recovery, is invariably "no." Three or four cases of hæmoptysis with recovery are reported as possible recoveries from plague, but in none was a bacteriological diagnosis made, nor did these patients infect anyone else.

These reports cover about 15,000 cases, so we may conclude that septicæmic cases without pneumonia constituted a very small proportion of the whole, probably about 1 per cent or less. There is no conclusive evidence of bubonic cases having occurred in these eighteen centers, and abdominal cases, if they occurred at all, were so exceptional as to be negligible for practical purposes.

The reports agree in giving about twenty-four hours as the minimum incubation period. Except for isolated instances of seven, eight, and even ten days, all agree in putting six days as the maximum. The mean is about four days. I obtained some information about one of the ten-day cases, and there seems to be little reason to doubt its genuineness.

A nonpneumonic case observed in Peking.—The first case diagnosed in Peking was that of an inn servant. He became ill on the afternoon of Thursday, January 19, and was brought to the hospital at 11 p. m. that evening, suffering from diarrhœa and vomiting. He could walk when supported, but was unsteady on his legs. He had fever and a rapid pulse. The next morning he was much worse; the pulse was very feeble, and delirium was present. His breathing was irregular but not labored. He got up and escaped from the isolation ward, but collapsed about 10 yards away, and died about half an hour later. Large purpuric spots appeared on the abdomen just after death. He neither coughed nor expectorated. We observed a well-marked chain of enlarged glands leading down from below the right angle of the jaw to behind the sternum. Repeated punctures of the largest of these, which was about 10 millimeters long and moderately hard, failed to reveal any fluid. *Bacillus pestis* was seen in large numbers in smears of the blood, and this organism was cultivated from the heart's blood. Its nature was confirmed by cultural tests. Smears of the stomach contents, obtained by puncture with a syringe, showed no plague bacilli. Unfortunately an autopsy was not permitted. Several people were in close contact with him without masks or any other protection, but no one was infected. I quote this as a typical nonpneumonic case, with the mouth as a possible route of infection.

NOTES ON THE INCUBATION PERIOD AND TREATMENT WITH SERUM

By Dr. J. CHABANEIX

Pei-T-Chen, a student of the Peking Union Medical College, who was engaged as a medical officer in antiplague work at Tientsin, fell sick on the afternoon of the 3d of February. He was living in a police station in the same room with one of his fellow-scholars, Ch'en Ch'eng Chang. Another medical student, Wang, examined the patient by auscultation, took some specimens of his sputum, and, not finding plague bacilli, believed that the case was not one of plague.

Ch'en and two sanitary policemen spent the whole night in the same room with Pei attending him. Two other policemen were also in contact with him. None of them took any special precautions.

On the morning of the 4th Pei began to expectorate bloody sputum containing plague bacilli. He was sent to the isolation hospital in the afternoon, and died in the night.

Ch'en, as soon as he heard the diagnosis of the case, fled to Peking.

Wang and the four other contacts were on the 4th injected by Dr. Robin with 20 cubic centimeters of Yersin's serum, and were then isolated. Wang received every day for four days a subcutaneous injection of 20 cubic centimeters of serum.

None of these five contacts were affected.

Ch'en, who went to Peking, was not inoculated until the 5th by Dr. Wenham. He received daily for three days 20 cubic centimeters of Yersin's serum subcutaneously.

He began to be sick on the 9th with fever, bloody sputum, and diarrhœa.

On the 10th and 11th, 40 cubic centimeters of serum were injected intravenously and 40 cubic centimeters subcutaneously.

On the 12th he received subcutaneously 60 cubic centimeters of serum and another injection of one minim and a half of Haffkine's vaccine. His condition was much improved. There was no more bloody expectoration, no diarrhœa, and no plague bacilli in the sputum; blood cultures were negative. The fever and pulse rate were so much less that there was serious doubt if the diagnosis of plague was correct. However, on the 13th the temperature and the pulse rate rose again, and death occurred on the 13th. Cultures from the heart's blood after death gave a growth of *Bacillus pestis.*

Conclusions.—1. In the case of Ch'en the incubation period was five days, and the disease lasted five days. Yersin's serum seems to have acted by lengthening both the incubation period and the duration of the illness.

2. With the five other contacts who escaped the disease we can not say that they were at the time in the same condition as Ch'en. But as these contacts have been treated in the way recommended yesterday by Professor Kitasato, we have thought the results of these observations, which may be regarded as almost experimental, were worth relating.

The next paper was upon

A SUMMARY OF THE CLINICAL SYMPTOMS OBSERVED IN THE PLAGUE PNEUMONIA THAT RAGED IN SOUTH MANCHURIA DURING THE MONTHS OF JANUARY TO MARCH, 1911

By Dr. KASAI

I would like to begin the discussion of the above subject with a few remarks about the material which was at our disposal. Two of the undersigned gentlemen, Dr. Kaya, professor at the Imperial University in Kyoto (who was sent by the Japanese Government to Manchuria to study plague pneumonia and who stayed for two weeks, mostly in Changchun), and Dr. Takahashi, his assistant, examined thirty-three plague patients. Three of these were examined in our hospital, the other thirty in Chinese isolation hospitals. In the latter, the two doctors had occasion to examine most of the patients only once; in 4 cases it was possible to examine them twice. The patients were all Chinese. Furthermore, Dr. Kuramoshi, director of the Railway Hospital in Mukden, and myself were able to examine eight patients clinically in our isolation hospitals, and besides that we obtained systematic particulars sent to us by different colleagues about a number of other plague cases. Regarding these particulars I would like to mention that I ordered at the beginning of the epidemic some specially printed forms for keeping reports, which I sent for distribution to the different doctors who were fighting the plague. Altogether 65 of these forms were returned to us filled with minute observations, and we would like to thank our colleagues very much for the trouble they took in preparing them.

The epidemic was raging in Manchuria almost entirely among the poor and very poor people (coolies, etc.). Few women and

children were attacked in proportion. Our statistics show that among the men those of medium age especially succumbed. This can be explained by the fact that the disease attacked large numbers of coolies who were nearly all from 20 to 40 years of age. The escape from infection of a boy aged 15 should be mentioned. While the boy was not attacked by the disease, his parents and his brother and sister, aged 2 and 10 years, who lived in the same house, succumbed.

From our statistics, the time of incubation is sometimes three or four but generally five days, very rarely is it more than a week (see Table I). Prodromal symptoms do not seem to occur.

TABLE I.—*Incubation period of pneumonic plague*

Incubation period.	Number of patients.	Per cent.
Within 24 hours	1	0.79
Within 48 hours	10	7.94
Within 72 hours	17	13.49
Within 96 hours	21	16.67
Within 120 hours	53	42.06
Within 144 hours	20	15.87
Within 168 hours	2	1.59
Within 192 hours	1	0.79
Within 216 hours	1	0.79
Total	126	

From 1,321 cases of plague pneumonia we have selected the above 126 in which the time of the infection could be accurately determined.

The disease usually begins with a chilly feeling, but a few cases do not exhibit this sign. In no case was a rigor noticed. Headache and loss of appetite were nearly constant symptoms; occasionally the following symptoms occurred: General discomfort, thirst, pains in the muscles and joints, nausea, and a feeling of pressure and fullness in the epigastrium.

We generally observed that the fever increases slowly, and the temperature reaches its height within twenty-four hours after the actual commencement of the disease, its highest point being 39° to 40°.5 C.

In the earliest stage of the disease the pulse rate increased rapidly, and counted more than 110 beats per minute; the rate of the pulse showed an average increase of 14.3 beats per minute for each increase per degree of temperature. (See Table II.)

TABLE II.—*Showing the relation of the increase of body temperature to the increase in pulse rate*

	Body temperature.	Increase in pulse rate.	Increase in pulse rate per degree of temperature.
	°C.		
1	38–40	12	6
2	38.3–39.3	8	8
3	39.3–40.1	10	[a]10
	37–39	24	12
	37.5–38.5	24	24
4	----------	----------	20
5	37–38	18	18
6	38–39	20	20
7	38.5–39.2	10	[a]10
8	----------	----------	20
9	39.6–40.5	20	[a]20
10	37–40	30	10
11	38.8–39.8	30	30
12	37–38	20	20
	37–38	10	10
	38–39	20	20
	39–40	10	10
13	----------	----------	17
14	----------	----------	20
15	37.5–38.5	10	10
	38.2–39.2	3	3
16	38–39	6	6
	39–40	6	6
	Average	----------	14.3

[a] About.

About twelve to sixteen hours after the beginning of the first symptoms coughing usually began, and the patients complained at the time of oppression and difficulty in breathing. The coughing was not painful, and the attacks were sometimes in short paroxysms and sometimes of longer duration. Nearly always the patients would expectorate freely. The expectoration first consisted largely of saliva, and then of a bloody mucus sputum. At this stage the face shows a peculiar reddening; the *conjunctiva bulbi* is more or less hyperæmically injected. The expression of the face is apathetic, anxious, or fretful. The tongue has a white coating, the fauces and the mucous membranes are of a diffuse red color. Sometimes the face shows a remarkable paleness with a slight cyanosis of the lips. The

pulse becomes weaker and more frequent, the number of respirations increases from 30 to 50. However, we have also seen cases in which the number of respirations remained normal or was only a little increased, whereas the radial pulse could no longer be felt. The respirations may be much increased but remain quiet. In not a few cases we observed very difficult breathing. Cyanosis is never absent in such cases, but it is clearly of not so high a degree as would be expected. Very seldom one finds similar cyanosis to that observed in Asiatic cholera. It occurs to every unprejudiced observer that weakness of the heart plays an important rôle. In the later stages the pulse can not be felt. The heartbeats, as shown by auscultation, are very frequent, and can not always be counted. The consciousness is generally clouded, and delirium may be observed. The voice loses its resonance, and speech is muttering. Notwithstanding this miserable condition, some of the patients are able to remain in a sitting posture, the upper portion of the body moving to and fro; other patients lie helpless in bed, but not for long, as they soon die. The sitting patients fall from their beds, and die on the ground.

SPECIAL SYMPTOMS

The *appetite* is at first not remarkably changed; afterwards it slowly diminishes, and finally there is no appetite at all. The tongue is thickly coated, especially at the root, and in the middle it is sometimes brownish and cracked. The patients complain of a feeling of pressure, accompanied by nausea and vomiting. In one case which we observed the patient vomited, shortly before death, a great quantity of yellowish mucus material. The back of the throat is nearly always injected and red. The tonsils on one side or on both sides are swollen.

The *fever* is mostly of a continued type. In the last stage the temperature drops from 38° to 37° C. In some cases it remains uniformly at 39° C. until death occurs.

The *heart sounds* are very weak and can scarcely be distinguished in the advanced stage of the disease. The limits of dullness of the heart do not show a distinct abnormality; in one case the heart was dilated to the right. (This case was observed by Professor Dr. Fujinami at autopsy; otherwise the heart was about normal.) This result is remarkable, as with Asiatic cholera the area of dullness usually completely disappears in the early stages. It is said that Mueller observed in plague pneumonia in India a similar acute symptom. In another case we noted once an accentuation of the second pulmonic sound.

Sometimes we could observe a dicrotic pulse. The heartbeats are weak and not distinct. Sometimes one can hear at the apex of the heart a slight systolic murmur.

PHYSICAL SIGNS IN THE LUNGS

Among thirty-three cases which were examined by Kaya and Takahashi we observed in five cases lobar dullness, corresponding to areas in which the respiratory sounds were markedly weakened, and rough, pleural, friction râles. In one case tubular breathing developed later. In other cases we could recognize, by auscultation, dullness in one lobe and weakened respiratory sounds, or sometimes resonant, sometimes finer moist râles. However, there are cases which show, on auscultation, an irregular distribution of the breath sounds over one lobe. In one case, on auscultation, we observed inferiorly numerous râles on both sides which were accompanied by dullness on one side. One hears, besides, now and then especially harsh, dry râles. We never could find, on auscultation, real crepitation over large areas, only in one case could we find a few crepitant râles in a small area. Physical signs were negative in four cases (these were mostly examined in the early stages) ; in nearly all of the cases we could determine with certainty the affected lobe. In five cases, which were later sectioned by Professor Fujinami, our observations were fully confirmed at autopsy. In those cases in which the course of the disease was slow and a thorough observation was permitted we were able to prove that a percussion performed early showed a resistance of the lungs, which was followed gradually by dullness. With these patients the vocal fremitus was weak in the beginning and increased afterwards in strength. Altogether the symptoms suggested rather a lobar pneumonia. The lungs showed as previously mentioned a remarkable change, but death occurred generally so quickly that the physical changes could not be followed.

Pain in the chest.—Complaints of pain in the chest were made by such patients in whom we found a pleural friction rub. In one of our cases the pain was very intense, in the others not very pronounced, and in one case it was altogether absent, notwithstanding the presence of a rather severe friction rub and the demonstration of a fibrinous pleurisy at autopsy.

Sputum.—In not all of the cases were we able to follow the regular investigation of the sputum through the course of the disease. Therefore, we examined carefully the sputa of different patients in different stages of the disease. From these examinations we have arrived at the following conclusions: In the be-

ginning the patient expectorates more saliva, and occasionally one can find therein, microscopically, a few plague bacilli mixed with other microörganisms (*Diplococcus pneumoniæ* of Fränkel and streptococci, etc.). A transparent, thin fluid and mucus sputum follows. Later the sputum ejected by coughing is mixed with streaks of blood, or part of it appears of a very pale reddish tinge. Finally the sputum appears deeper red, at first brick-red, later appearing like raspberry syrup. The viscosity of the sputum also increases; sometimes it is jelly-like, sometimes rather thick and viscid, but it never reaches the degree of viscosity which is customarily observed in true croupous pneumonia. Even in the last condition the sputum is nearly always mixed with fine air bubbles. In the blood-stained sputa plague bacilli can be seen in almost pure culture. In the sputa of our few cured cases, plague bacilli could no longer be found in one case after six days, and in two cases after thirteen days. We have seen real hæmoptysis in no case. It was observed that from the mouths of those who had dropped to the floor dead, a great amount of dark-red blood had streamed. We examined the blood in one of these cases, and found that it contained an enormous quantity of plague bacilli. We can not say at this time if these hæmorrhages arose from hæmoptysis or from hæmatemesis. We also had one case in which a profuse bleeding from the mouth occurred, and at the autopsy Dr. Otsuki found rather large ulcers of the stomach. Professor Fujinami also found in one of his autopsies multiple ulcers of the stomach. However, cases of this nature occurred rarely. The quantity of the sputum ejected at one time was small, and reached in the course of one day scarcely a total of 50 cubic centimeters.

Coughing.—As we have mentioned already, the cough is generally very loose, never painful, either short and spasmodic or prolonged.

Skin.—The color and moisture of the skin are at first normal. Subcutaneous hæmorrhages do not occur very often; but in those cases in which we observed them they were extensive, and also small petechiæ occurred over the chest, back, and extremities. Sometimes we saw rather larger hæmorrhages on all portions of the body.

Abdomen.—The abdomen never showed marked changes; sometimes it was inflated, sometimes sunken, without pain on pressure.

Spleen.—In one of our thirty-three cases the spleen was enlarged and was palpable for about 2 centimeters below the arch of the ribs. In a second case it was only just palpable. Usually the

spleen was not palpable; in three cases it was enlarged, as proved by percussion.

Lymphatic glands.—In two of our cases the inguinal glands were swollen to the size of a bean; they were indolent and not adherent to the surrounding tissue. One case was sectioned and examined bacteriologically, after which examination it was clearly proved that the glands were not plague glands. In no other case have we found an increase in size of the neck, axillary, and inguinal glands.

Mental condition.—The consciousness is in the beginning absolutely clear. Toward the end of the disease it is often clouded; delirium is seldom seen. If we requested the Chinese interpreter, who accompanied us on our visits to the patients, to speak to them, he was either not understood or the patients replied falsely.

Blood.—At the last stage of the disease the blood is dark red, as though coagulated, and one to three drops emerge very slowly after a vigorous prick with a needle. An exception was noted in only one case in which the blood was pale red and watery, and could not easily be stopped. (This case was observed at autopsy.) Plague bacilli were shown to be present in the blood in five out of eight cases examined microscopically or by cultures.

The *urine* was generally clear or slightly cloudy; its reaction was acid, and its specific gravity 1024 to 1034. In six cases which were examined, albumen was found twice. The diazo, indican, and sugar reactions were all negative. In one case only, plague bacilli were found by cultures. The examination of the urine was done without a centrifuge. Bloody urine was not observed, but at the autopsy of one case the pelvis and the urinary bladder were filled with blood.

The *fæces* were usually yellowish and soft. In one case we found, by microscopical examination, a few plague bacilli. In another case the existence of these organisms was proved by animal infection.

The course of the disease.—Sufficient evidence was not obtained from the material with which we worked for us to decide conclusively in regard to the course of the disease. The Chinese patients, whom we observed in our wards and in the Chinese isolation houses, generally died on the day after the first examination. Therefore, one of our colleagues was asked to note statistically the course of a great number of cases. From these observations it was established that the duration of the disease is generally two days, after which death occurs. We were only

able to observe five cases twice, the disease in these being of a somewhat prolonged duration.

In two cases death occurred twenty-four hours after the first examination.

In one case death occurred thirty hours after the first examination.

In one case death occurred thirty-four hours after the first examination.

In one case death occurred fifty hours after the first examination.

TABLE III.—*Duration of the disease*

Death within—	Number of patients.	Per cent
24 hours	24	16.00
48 hours	81	54.00
72 hours	26	17.33
96 hours	11	7.33
120 hours	6	4.00
144 hours	1	0.67
168 hours	1	0.67
Total	150	

From 1,321 cases we have selected the above 150 in which the beginning of the disease could be accurately determined.

The *prognosis* is unfavorable, notwithstanding that we saw a few cases cured probably by serum which was injected after the beginning of the disease.

Finally, I would like to mention that in our examination of railway travelers in the cars and at the stations or in the inspection of houses we were obliged to observe principally the following mentioned, special symptoms: The expression of the face, its color, and the condition of the pulse. In this way we were able to find out best if we had encountered a plague suspect. The early recognition of suspects is of great importance in combating the plague.

(Signed by Dr. Kaya, professor of the Imperial University at Kyoto; Dr. K. Takahashi, assistant at the Railway Hospital at Changchun; Dr. H. Kuramoshi, director of the Railway Hospital, Mukden; Prof. Dr. Kasai, director of the Railway Hospital, Dairen.)

Dr. FARRAR moved that the Conference now adjourn and discuss these interesting papers at the next session.

Dr. STRONG asked if it would not now be possible to have afternoon sessions, in order to make more progress with the work.

Dr. FARRAR thereupon proposed that in future the Conference should meet upon Tuesday and Thursday afternoons and Saturday mornings.

This was seconded by Dr. STANLEY, and on being put to the meeting was carried by a majority.

H. E. ALFRED SZE announced that if there were any necessity for obtaining the services of another stenographer he would do his best to secure one.

The Conference then adjourned until the following day.

SESSION X, APRIL 14

PROGRAMME ARRANGED FOR THE DAY

I

B. Clinical Data (continued).

1. Types of the disease met with during the past epidemic apart from primary pneumonic plague.
2. Incubation period.
3. Symptoms.
4. Diagnosis.
5. Prognosis.
6. Treatment: Serum, vaccine, chemotherapy, drugs.

II

A. Epidemiology.

6. Has there been a spontaneous decline in the past epidemic—i. e., apart from the influence of preventive measures; and, if the evidence of this exists, what is the cause of the decline.
7. Data relating to the origin of infection in villages and towns:
   a. The importation of persons incubating the disease, or of sick persons, or healthy carriers of the disease.
   b. The importation of infected clothing or merchandise.
8. The infectivity of the plague patient.[1]

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Clinical notes of an epidemic of pneumonic plague in Bombay and its relation to the present epidemic.
3. Discussion of clinical features of the disease; diagnosis, prognosis, etc.
4. Data relating to the origin of infection in villages and towns.
5. Spontaneous decline of the epidemic.
6. Origin of the infection in Tientsin.
7. Infectivity of the patient; noninfectivity of merchandise or clothing.
8. Infection by healthy carriers of the disease.
9. The plague epidemic at Harbin.

[1] See also Session VI, pages 83 and 90.

PRELIMINARY BUSINESS

The meeting opened at 10 a. m., Dr. Wu taking the chair.

The minutes of Session IX were passed.

The MEDICAL SECRETARY read the following resolutions proposed by Professor Kitasato.

1. That papers, hereafter, shall not be longer than from fifteen to twenty minutes.

2. If read in German or French, a short résumé must be handed before to the Secretary, for the English translation.

3. In the discussion no speaker is to speak for more than from three to five minutes.

4. No one is to speak more than twice upon the same subject.

These rules were seconded by Dr. PETRIE and adopted *nem. con.*

The CHAIRMAN. The Secretary is to be the official timekeeper. The first paper to-day will be read by Dr. di Giura.

The following paper was then read upon:

CLINICAL NOTES OF AN EPIDEMIC OF PNEUMONIC PLAGUE IN BOMBAY AND ITS RELATION TO THE PRESENT EPIDEMIC

By Dr. DI GIURA

The clinical and epidemiological features of the pneumonic-plague epidemic in Manchuria seem to correspond largely with those of the Bombay epidemic of plague in 1898 in which epidemics of the pneumonic variety were only incidental.

Dr. Polverini, who worked two years in Bombay with Professor Galeotti, described minutely a pneumonic-plague epidemic which broke out in the Maratha Hospital at the end of September and beginning of October, 1898, in which the staff of the hospital suffered heavy losses.

At that time bubonic plague in Bombay was nearly over, and the daily average of cases was ten; not all of these patients were treated in the hospital.

It is difficult to say how this pneumonic-plague epidemic began, but it is known that the first one infected was a man who was engaged in working on the removal of dead bodies.

This first patient was sent to the hospital. He had been sick for three days with high temperature and dyspnœa, and was found to be suffering from an undoubted attack of pneumonic plague. He also vomited blood, and died after 3 days.

The second case was a nurse who attended Case No. 1. She fell sick on the 23d of September and died on the 24th, after only thirty-six hours' illness.

The third case was an assistant of the hospital. On the night of the 23d he had attended the second case. On the morning of the 25th he was not quite well, and was unable to do his work in the hospital. He was treated by Dr. Choukar, the director

of the hospital. On the 26th of September he was brought to the hospital and was found to be expectorating and vomiting, and was delirious. He died 14 hours after his arrival.

The fourth case was the wife of Case No. 3. She assisted him, fell sick on the 25th, and died at the hospital on the 27th.

The fifth case was that of Dr. Choukar, who attended the second and third cases. On the 29th of September he had fever and headache. He had not been ill previously. He was conscious on examination, but had epigastric pain, a temperature of 103°.2 F., respirations 36, pulse 132, of low tension and easily compressible.

The ocular conjunctivæ were not injected, the pupils were normal; there was nothing suggestive in the facies; the tongue was coated, and there was great thirst, dyspnœa, and sternal pain. It was difficult to find the apex of the heart. The transverse diameter of the heart was increased; symptoms of pneumonia and pericarditis were present; the liver was normal; the spleen a little enlarged.

On examination of the sputum, an enormous number of plague bacilli was found but no other bacteria. Leucocytes, mucus, and erythrocytes were also present.

Until October 1 the condition of the patient remained stationary, but in the evening of the same day the temperature rose to 105°.3 F., and the patient was delirious all the night. The dyspnœa increased, the cough remained severe, and the expectoration difficult. Later on he became comatose; the pulse was very small, 172 per minute. He grew steadily worse, and died on October 2. No evidence of bubonic infection was found. Here then was a typical example of primary pneumonic plague in which the infection certainly was incurred aërially through contact with another pneumonic-plague patient.

The sixth case was that of an Indian doctor who assisted Dr. Choukar. The case was almost identical with the previous case, and was also one of plague pneumonia with cardiac complications. The patient died on the fourth day.

The seventh case was a store attendant of the hospital. He attended Dr. Choukar during two nights, and fell ill on October 5. He had pneumonic plague and small femoral buboes. He died on October 12.

The eighth case was a relative of Dr. Choukar, a boy who was at the doctor's house. He fell ill on October 6, and died on the 9th from pneumonic plague.

The ninth case was one of Dr. Choukar's assistants. He fell ill on October 9, was extremely delirious, and died on the 13th.

During his sickness two brothers came from the country to see him, and both of them also died from pneumonic plague.

After this, two nurses died at the hospital, and also one female nurse who was engaged for the purpose of attending the patients.

In all these cases the pneumonic type of the illness was the same as in that case which transmitted the infection. The above cases, which all had identical clinical symptoms, left no doubt as to the way in which the transmission of the disease took place, and energetic steps were taken to end the epidemic. The patients and the contacts also were isolated. Thus the epidemic was stopped.

I mention these cases, as it seems to me that there is a great similarity with what happened in Manchuria, when the epidemic broke out among the lower classes of people and was rapidly diffused by overcrowding. As soon as the medical service became efficient and isolation was rigorously carried out, the epidemic diminished and disappeared.

Also in the last Manchurian epidemic there was not a case of typical bubonic plague found, pneumonic-plague patients always caused pneumonic plague.

These clinical observations I have the honor to report to the Conference have been corroborated by experiments on monkeys made by Dr. Polverini, who demonstrated many years ago that the plague bacilli, which multiply in the lungs of the monkey, acquire the capacity to localize in the lungs and cause only pneumonic plague, not only when infection occurs by the bronchial passages but by the lymphatic vessels or blood vessels.

From these experiments it would also appear that the plague bacilli which have overcome the resistant power of the epithelium of the lungs acquire as a new property not only a greater virulence but also the special property of localizing in the lungs. This is also found in other infectious diseases, and, as you know, there are bacteria which can be pathogenic only for a single species of animal and also bacteria which can localize only in one organ and not in others.

DISCUSSION OF CLINICAL FEATURES OF THE DISEASE

Dr. STRONG. Our observations agree with those of Dr. Christie and Dr. Ch'uan upon the frequent absence of marked physical signs in the chest in cases of pneumonic plague during the present epidemic. First, in regard to percussion. Even in cases well advanced in the disease, distinct dullness may be absent. Vocal fremitus and resonance give little information of the character of the pulmonary involvement. On auscultation, râles

are frequently not present even in very sick cases; when present they are usually fine. Coarse râles such as occur in cases of catarrhal bronchitis are rarely heard, and I have not observed them in our pneumonic cases uncomplicated with microörganisms other than the plague bacillus. The numerous moist râles which are commonly encountered late in the disease are due to the marked œdema of the lungs. The character of the râles is what one would expect from the condition of the bronchi, the character of the exudate, and the condition of the lungs observed at autopsy. Feeble respiratory sounds, tubular modification, or pure tubular respiration are the conditions most commonly found on auscultation, and not infrequently a dry, pleuritic rub. The signs of cardiac involvement are always marked in advanced cases; there is usually a very rapid, feeble, running pulse. Dyspnœa and gallop rhythm of the heart sounds are usually noticed, and sudden cardiac collapse is frequently observed. One can not doubt that death occurs from intoxication and from paralysis of the heart. In several instances we saw death occur from cardiac collapse in the attempt to move patients from one ward to another. Some of these cases appeared in fairly good condition just prior to their being moved. Death also occurred from the same cause in one or two instances after the patient had sat up in bed for a few minutes to take nourishment. The bacteriological diagnosis is the only certain one, but from the general condition of the patient in connection with the absence of marked physical signs in the lungs the diagnosis of plague was often strongly suggested; cases with numerous coarse, bronchial râles in the lungs are usually not plague cases. Labial herpes was never observed in any of the cases in the hospital, which is interesting on account of its frequent occurrence in croupous pneumonia. This last point has been called attention to in pneumonic epidemics that have occurred before.

Dr. Petrie suggested that discussion should proceed upon each point in the first part of the morning's programme in succession.

Dr. Aspland suggested that that would involve a great deal of time under the new rules.

Dr. Farrar said that he would like to ask for more information as to the intestinal type of the disease. It had been passed over rather lightly, and he believed that there were some present who could certainly give further evidence in regard to the intestinal type. In one case that he had seen himself at Chefoo there appeared to be no pneumonia. The patient was certainly feverish and ill, and had the typical plague pulse. His excreta showed an

almost pure culture of plague bacilli. It seemed to him that cases of this kind must be more frequent than was generally recognized, and that details of them would be extremely important.

Dr. ASPLAND said that he could give three instances, not of intestinal plague but of the absence of it under circumstances where one would naturally look for it. Out of four women who died very rapidly in the quarantine wagons from plague pneumonia, three were nursing young children up to within two hours of their death. In the rush of work he had overlooked the fact of making any bacteriological examination of the milk, but from what they had heard, one would naturally conclude that there would be large quantities of bacteria in the milk, and yet none of these children developed plague.

Professor GALEOTTI stated that he remembered when he was in India in 1897 there were two or three cases of natives in Poona who had symptoms of cholera. These men had eaten flour in which dead rats were found. Bacteriological examination of the fæces resulted in plague bacilli being found. At the time this was spoken of as the intestinal form of plague. These observations appeared to confirm the possibility of the localization of plague in the intestines. Though similar cases were looked for he had not found any other, and, therefore, he was unable to come to any definite conclusion as to the localization of the microbe in the intestines.

Dr. PETRIE. Did you confirm this observation by cultures?

Professor GALEOTTI. Yes.

Dr. PETRIE. Did you plate out the bacilli from the fæces?

Professor GALEOTTI. We made plate cultures.

Dr. PETRIE. Were animals inoculated with the culture?

Professor GALEOTTI. No, we made microscopical and cultural tests, but did not confirm them by inoculating animals. We were sure that they were plague microbes.

Dr. CHRISTIE asked whether it had been confirmed bacteriologically that the milk contained plague bacilli.

Dr. BROQUET said that, so far as he knew, no investigations had been made upon this point.

Dr. FARRAR said that it would be interesting to know whether Dr. Ku [1] did or did not have *pestis minor*.

Dr. WU said that he had examined Dr. Ku when he was feeling slightly ill. No plague bacilli could be found in his throat or sputum, though he had hæmorrhagic sputum. He might con-

[1] A Chinese physician who worked without masking in the plague hospital at Fuchiatien.—[EDITOR.]

clude the discussion upon this point by citing a case, the only one he had observed in over 260 he had examined in the hospital at Fuchiatien. This patient complained of no other symptom but diarrhœa. First of all he passed solid yellowish stools. He [the speaker] had examined the sputum, the blood, and the fæces. In the sputum and blood he found no bacilli. In the stools he found a culture of plague-like bacilli. Unfortunately when he hurried to the hospital soon afterwards to obtain cultures he found that the patient had already died, after passing bloody movements the preceding night.

Dr. K. Y. LIN said that in the last epidemic of bubonic plague at Tongshan in 1908 abdominal types had been observed. Microscopical examination of the fæces, cultural tests, and inoculations of animals with the fæces gave positive results.

Professor ZABOLOTNY said that these observations did not, in his opinion, prove at all that there had been cases of primary intestinal plague. These experiences only showed that plague bacilli passed through the intestinal passages, or came perhaps from hæmorrhages of the mucous membranes of the bowels.

Dr. PETRIE stated that so far as he knew the most careful investigation upon this point had been done by the Plague Research Commission in India. They had adopted Albrecht and Ghon's method, and had made inoculations from the fæces of bubonic cases upon guinea pigs. In only one doubtful case was infection produced. This case was rather doubtful, because in taking the fæces from the rectum it was not certain that there had not been a small abrasion which produced blood in the fæces. These experiments appeared to show that a short time before death the fæces were not infected.

Dr. FUJINAMI said that in all the cases he had observed he had seen no symptom of intestinal plague with the exception of one case which might have some bearing upon this subject. In this case he had found a few plague bacilli in the Peyer's glands. Dr. Otsuki, who made the post-mortem examination, saw hæmorrhages in the colon, and found these bacilli. He agreed with Professor Zabolotny in saying that in many cases of plague pneumonia hæmorrhages could be found in the bowels, and that these might account for the bacilli being in evidence there.

Dr. STRONG. I believe that if intestinal plague were at all a common condition we should have found it very frequently in this epidemic, where we know that in many instances patients must have swallowed enormous numbers of plague bacilli in their sputum. When you consult the records of epidemics of bubonic plague extending over many years, I think you will fail

to find any human cases recorded of undoubted primary intestinal plague. The nearest case of this kind that I have been able to find in the literature upon this subject is one reported by Albrecht and Ghon in 1906. In this case there was a small ulcer in the small intestine, and there was a rather serious involvement of the mesenteric lymphatic glands. Even in this case the evidence is a little doubtful, but it is the nearest to a case of primary intestinal plague that I know of. During this epidemic none of us who have performed autopsies have found serious evidence of intestinal involvement, and that fact would certainly speak against the existence of primary intestinal plague, and would seem to show that even though the intestines might be secondarily involved this condition in human beings must be a very rare one also.

Professor KITASATO. We have made many observations in connection with plague epidemics in Japan, but we have never seen primary intestinal plague. It may be possible that this type can be found among rats, but in man intestinal plague starts in the patient's last moments of life—that is, when he has plague bacteræmia. It is only in the last hours of the sickness that this condition can be found, either in plague pneumonia, cutaneous plague, or bubonic plague. Primary intestinal plague has not been proved to exist yet.

Professor ZABOLOTNY said that he agreed. Intestinal plague of rats could be produced experimentally, but it had never been found at any post-mortem examination upon plague patients. He had found plague bacilli twice in the fæces of plague patients in Harbin, and confirmed this by full bacteriological examination, but he had not found any primary infection of the bowels.

Professor ZABOLOTNY said that Dr. Bogucki would explain in regard to the incubation period of contacts.

Dr. BOGUCKI stated that during the whole epidemic (at Harbin) 10,114 persons had been under observation, and out of this number 180 Chinese and 2 Russians who contracted plague were isolated. The suspects under observation were placed in cars specially fitted up, 10 to 25 persons in each car. The largest number of plague patients in each heated car was never more than 12. In the night asylums and opium dens, infection was often carried by means of the pipes that were passed around from mouth to mouth; to illustrate this, he could state that one pipe was the cause of 14 plague cases. In conclusion, he stated that the interval between each individual infection was not over three days.

Dr. HAFFKINE asked how many plague patients had been cured during the recent epidemic. If the doctors replied to this question the *prognosis* of the disease could be stated.

Dr. HILL said that he would like to hear whether there were any symptoms that were diagnostic of pneumonic plague; if from the occurrence of any symptom, such as a rigor, one could say that a suspicious case was not a plague case.

Dr. ASPLAND said that he would like to emphasize Dr. Hill's remark and call for information upon that point, because at the height of the epidemic at Fuchiatien he himself had been taken with chills and fever, which ran to 102° F. He spent the most uncomfortable twenty-four hours in his life, but was comforted the following morning by being told that the onset of pneumonic plague was never accompanied by chills.

Dr. STRONG said that he considered it a little unfortunate that they had not received more data on experimental clinical observations. Data upon these questions had been meager.

Dr. FARRAR thought that more might be said about the pulse in plague. According to the few observations he had made, the pulse in plague had a very special character. It had a thin, sharp, sudden beat, and was very easily compressible. If some physician more experienced than himself on this subject could give the Conference a description of the typical plague pulse, he thought that it ought to be recorded in the report when the latter was drawn up. At Chefoo he had visited the plague hospital, and went in the ordinary course to the poor house afterwards. There, there were six people, not one of whom was heard to cough. He suggested that they should all be made to expectorate, which they did, and they all expectorated blood. They were taken to the hospital, and all were dead the following day. The particular feature about these people was that none of them looked particularly ill and that they all declared that they were not ill.

Dr. STRONG asked if anyone had prepared pulse and blood-pressure tracings.

Dr. KASAI said that so far as he knew no one had made any sphygmograms.

Professor GALEOTTI stated that when in Bombay he had collected a great many pulse tracings of plague patients. Their sphygmograms were very peculiar. He had compared these tracings with those obtained experimentally from animals infected with the plague endotoxin. In many cases there was even a dicrotic condition of the pulse. The plague endotoxin exercised

a specific effect upon the heart and upon the muscular fibers of the arteries, and produced distension of the arterial walls and paralysis of the heart.

Dr. ASPLAND referred to the fact that in his paper the preceding day Dr. Ch'uan, referring to the work at Fuchiatien, gave a very different description of the plague pulse from that given by Dr. Christie. In quarantine work at the same place he had examined 1,500 to 1,600 persons per day, and there they had not found the full, bounding pulse described by Dr. Christie but a markedly soft and compressible pulse. In the latter stages—that was to say, when the patients had presumably developed the disease during the night and were already expectorating blood—the pulse was distinctly irregular, the fluttering pulse described by Dr. Ch'uan. A point that had not been referred to was the falling of the temperature to well below normal in the later stages. Four to six hours before death the thermometer would not rise above 96°.5 or 97° F.

Dr. CHRISTIE said that, strange to say, in his experience at the railway station the disease seemed to attack only the strong and healthy. His observations were made largely at the beginning of the disease—that was to say, before any weakness had manifested itself. He had taken special note of the pulse he had described as a diagnostic sign. As the disease advanced and the patient got weaker, there were distinct signs of cardiac failure. The pulse then became rapid, feeble, compressible, and fluttering. He was speaking entirely about the beginning of the disease when he referred to the pulse as being full and ranging from 88 to 100. If the patient was a weak subject to begin with, one would expect to find a weak and rapid pulse. With a strong, healthy man, the pulse was full, bounding, and regular.

Dr. HAFFKINE said that the pulse at the beginning of the disease was always secondary to the temperature; there was a tendency of the heart to gallop and the pulse to get thready.

Professor ZABOLOTNY said that the pulse was very variable, and changed very rapidly. In the morning it would appear to be very good and in the afternoon it would be scarcely perceptible. He and Dr. Broquet had observed this in the case he had referred to at a previous session. In the morning the patient's pulse was very good, but in the afternoon it could hardly be felt. It made no difference in plague pneumonia whether the temperature was high or not. The pulse might be irregular when the temperature was quite low as well as when it was high. The plague toxin appeared to have a very great toxic effect upon the heart. The pulse became soon irregular and weak. In

cases where patients recovered [1] it had been observed that the pulse remained thready, very weak, and irregular for a long period.

Dr. Strong asked if any observations had been made with blood counts during this epidemic. If this question were not discussed it might be forgotten and not mentioned again. He had estimated the leucocytes in three cases and had found distinct evidence of leucocytosis in two. His blood counter had not arrived until the epidemic was about over.

Dr. Gray said that Dr. Koulecha had stated in his paper that no leucocytosis was observable in the tissues. He asked whether anyone had used the Thoma Zeiss leucocytometer.

Professor Galeotti said that leucocytosis was a very common phenomenon in infectious diseases, and he thought that it was accentuated in the case of plague. He had examined a great many bubonic plague cases, and generally found a very high leucocytosis. This was very easily explained, because the plague toxin had a very marked chemotactic effect.

Dr. Strong stated in reply to Professor Galeotti's remarks that he agreed that it was quite true in regard to what had been said about the positive chemotaxis in infectious diseases in general. But an organism which might ordinarily cause a leucocytosis (as in bubonic plague) when the infection became very acute and severe (as in pneumonic plague) might produce the opposite effect and no leucocytosis result. Apparently in these instances the host was overwhelmed by the toxin, and the leucocytes fled from the invading organism, a condition of negative chemotaxis being produced. This condition might occur in cases of plague pneumonia in which the infection was very severe and acute.

Dr. Gray thought that the Conference ought to have some information upon the question of differential diagnosis, which appeared to have been passed over.

Dr. Wu said that the observations he had made at the hospital at Fuchiatien agreed with those made by Dr. Aspland in the quarantine station. It seemed strange that the condition of the pulse should be so different in the cases described by Dr. Ch'uan and Dr. Christie. In his experience he did not think he could remember a single case with a slow, full, bounding pulse. His cases had mostly been in coolies, who were certainly very healthy and strong, and yet when the disease attacked them the pulse at once became very fast, certainly never under 100,

[1] This refers to bubonic plague.—[Editor.]

and usually about 120. In the case of one of the Chinese students who died from plague, the character of the pulse first made him suspicious. This student reported himself ill with slight fever. He had a very anxious expression, but nothing appeared to be wrong with his throat or lungs. However, the pulse was over 120. It was fast, small, and easily compressible. For twenty-four hours this student had no sputum, but after that time the sputum appeared containing numerous bacilli, and he died the same evening at 6 o'clock. They had found no case of dicrotic pulse as in typhoid. As to blood counts, he had two counting apparatus at Harbin, but the condition of the hospital was so bad that he thought it better not to risk using them. As regards the pulse, he felt sure that the Conference would like to hear more from those who had had some experience.

Dr. CHRISTIE. Did you say that the pulse was weak at the very beginning, even in the strong and healthy?

Dr. WU. Yes.

Dr. FARRAR asked if it had been brought out that the physical signs revealed by stethoscopic examination were very few in comparison with the extent of lung tissue involved and the amount of sputum.

Dr. STRONG said that Dr. Christie had referred to that the preceding day, and he also had mentioned it that morning.

Dr. GRAY asked if anyone had tried lung puncture for diagnosis.

The CHAIRMAN said that he thought that the questions of serum and vaccine treatment had been fully discussed in the bacteriological section, but he felt sure that everyone would be interested to hear something upon the subject of "Chemotherapy."

Dr. STRONG was pressed to speak upon this point, but replied that his results on this subject up to the present time had been too indefinite, and he could say nothing about it yet.

Dr. HAFFKINE said that as in the epidemiological programme there were questions which had already been examined in the section upon bacteriology, he thought that these matters should be referred to a committee of Delegates to draw up resolutions to submit to the Conference.

Dr. ASPLAND pointed out that that had been done already, and that the first part of the work of the Conference consisted in receiving and discussing information, while the drawing up of resolutions did not come until the second part.

The second part of the day's programme was then proceeded with, the following paper being read upon

DATA RELATING TO THE ORIGIN OF INFECTION IN VILLAGES AND TOWNS

By Dr. GRAY

Before dealing in detail with the origin of infection in various villages and towns, I wish to consider carefully the origin of infection at the town of Manchouli,[1] which we have heretofore regarded as the starting point of the recent epidemic. The question before us is: Did this Manchurian outbreak arise among tarbagan trappers in the neighborhood of this town as a result of infection from these animals, or did it arise as an extension from other localities where pneumonic plague had already appeared.

There is no evidence that the past season was specially marked by an outbreak of "tarbagan disease." Moreover, in previous years the trappers have been subjected to the same conditions of overcrowding accompanied by the privations incidental to a rigorous climate. Nevertheless, the infection of a single trapper by sick tarbagans, assuming that the disease were to take a pneumonic form, would have been enough to start an outbreak of infection in such a community. We have had numerous specific instances of late showing how one sick visitor was able to infect a whole village or town, causing tens and hundreds of deaths. Therefore it is quite possible that the outbreak may have owed its origin to the arrival of an infected man in the trapping community, the infection finding there ample opportunity for its spread.

With regard to the tarbagan, the results of our bacteriological investigations so far have not given us any grounds for believing that it is specially susceptible to plague,[2] though it might be said that comparatively little work has as yet been done on this point. At the same time, "tarbagan disease," which is characterized by lymphatic swellings and which doubtless is plague, occurs as a well-recognized epizoötic.

If the tarbagan is so infective to man as to originate an outbreak of such virulence as the recent epidemic, a heavy responsibility rests with those who allow the continuance of trade in its skins, more than two millions of which are now exported annually by the Trans-Siberian Railway to Moscow en route to Leipzig and London. But is this animal really the *"fons et origo mali?"* Professor Zabolotny, who has sought for years for bacteriological proof of plague among these animals,

[1] Manchuria station.

[2] For evidence of susceptibility of tarbagans see pages 237 and 385.

has never succeeded in finding a plague-infected tarbagan.[1] Moreover, according to Dr. Ch'uan's evidence obtained from medical and other authorities on the spot, among the four companies near the station of Manchouli who handle the entire trade in the marmot furs not a single employee was affected. Suppose for the moment we put aside the tarbagan as the origin, is there any other possible source of infection?

About the 20th of September, 1910, a man who had plague traveled from Borsja (on the Trans-Siberian Line) to Akurei, and introduced infection there.

At the end of September, 1910, seven carpenters died after expectorating blood in the workshop of Chang Wan Shun at Dawoolya station on the Trans-Siberian Railway. They lived in a house next to Wu Ling's inn. At that time there was no mention of any infective outbreak in Manchuria. Later on, as Dr. Ch'uan told us, nine out of twenty coolies who lived in a small room in Wu Ling's inn became infected. One of these men was taken to the Russian Railway Hospital, and it was discovered there that he was suffering from pneumonic plague. The others escaped and disseminated the disease. These facts were cited to Dr. Ch'uan by Dr. Brisemski the Russian Railway doctor, and give us very good ground for believing that there was at this time a small epidemic of pneumonic plague at Dawoolya, six miles west of the boundary line.

It requires little stretch of imagination to see how an epidemic could be caused, irrespective of any tarbagans, by the arrival of one of these infective agents in such an easily infected community as we now know the trapping community to have been.

Sporadic outbreaks have been occurring in trans-Baikalia and in northwest Manchuria for years past, and whether we look upon the infection as having spread from west to east or from east to west is almost immaterial, so long as we remember that we have here a vast region subject to outbreaks of plague, mostly of the pneumonic variety, conveyed directly from man to man without the intervention of rodents. When a human carrier of infection can not be traced, then we must seek for evidence of rodent infection. During the latter half of 1910, so-called "household attacks" occurred at Akhsha on the Russo-Mongolian frontier, and it is most probable that these were caused by infection from marmots, as the people here trap and handle

[1] In a personal communication received from Professor Zabolotny while this report was in press, the information is given that he has found complete evidence of plague in a tarbagan, the plague bacillus having been identified at the autopsy both microscopically and culturally.—[EDITOR.]

them. Many of us have regarded this recent epidemic as having originated among the tarbagan trappers around Manchouli station, without taking into account the factor of direct human contagion. When the time arrives for this Conference to make recommendations, I hope it will not lose sight of these points, for the lesson they teach is the importance of frank and rapid notification between the two countries most concerned of sporadic plague outbreaks, however small.

The following is a list of Russian towns in trans-Baikalia where the occurrence of plague has been officially notified during the past eight months: Tarbagatai, Petrofski, Verkneudinsk, Akhsha, Akschinsk district, Dawoolya, Charanor, Sharasun, Akurei, Alouianaya, and Borsja.

The origin of infection in the different towns in Manchuria, Chihli, and Shantung is a comparatively simple matter, depending on the arrival of infected persons. In the many reports I received from all over the infected areas and in the answers given to Dr. Hill's lists of inquiries, I could find no instance of spread other than by human agents except at Liaoyang, where there is a specific instance given of infection having been introduced by coffins.

The following is a list of the more important places in which the origin of infection was definitely traced.

Harbin and Mukden.—Many sick people arrived from Manchouli.

Hulanfu.—A batch of 8 coolies came from Fuchiatien on December 13, infecting the inmates of two houses, all of whom died.

Ashiho.—Merchants from Harbin. The infection began on December 24, in an inn.

Changchun.—A merchant named Chang returned to his shop, and infected his relatives on December 28.

Kirin.—A cart driver called Chang Yu Kuei arrived on the 17th of January from Changchun after two days spent on the road. He died in an inn after infecting others.

Fakumen.—A native of the place returned here from Mukden on the 19th of January and died two days later.

Kwangninghsien.—The infection was introduced here by two carters from Mukden on the 14th of January.

Liaoyang.—A coolie arrived at Lishan station, south of Liaoyang on the 6th of February at 7 p. m. He went to a Chinese inn, and at 8 p. m. was invited by the innkeeper to take supper at the same table with six others. During the meal he began to cough, vomited, and was unable to finish his supper. Here he infected the others. He died at 1 a. m.

Yungpingfu.—A coolie came by rail from Harbin. He fell ill on the 3d of January, two days before arrival here; he died on the 5th of January shortly after reaching his home.

Tientsin.—A merchant from Mukden arrived in the Austrian concession and died on the 13th of January from plague. Returning coolies, however, were the origin of the hundred-odd deaths that occurred here.

Kaiyuan.—A soldier from Changtu, which was an infected place, arrived at an inn on the 26th of January. He became ill the following day, and at first refused to be inspected. Next day he was removed to the hospital and died the following day. All of the staff of the inn died in the next few days, with the exception of the innkeeper, who ran away and infected surrounding villages.

Peking.—A merchant from Harbin came here to collect rents, and died of plague. From this case a definite series of infections originated, which are noted fully in my complete report.

Dairen, Chefoo, Shantung, and Chihli alll owed their infection to returning coolies.

A paper was then read upon the

SPONTANEOUS DECLINE OF THE EPIDEMIC

By Dr. ASPLAND

Shuangchengfu, a city of 60,000 inhabitants, situated near the railway about thirty miles south of Harbin, as described in the Chairman's opening address, is a city of wide streets, large houses and compounds, open spaces and manufactories, and in every way there is a strong contrast to the narrow streets and dirty hovels of Fuchiatien. It was indeed in every respect a city from which the best could be hoped in the event of an epidemic. Here the first plague case was reported on January 25, 1911; the epidemic reached its height about February 20, when the death rate in the whole district was almost 200 a day, and by March 16 the plague cases had fallen to below five a day. Thus the period from the beginning of the epidemic to its climax was about four weeks. The total number of deaths in the whole prefecture was 5,572. In this place no attempt was made to secure segregation of contacts; there was no proper hospital for the sick, no disinfectants were used, and very little money was spent on precautions of any kind. The intensity of the epidemic may be judged from the fact that during a month 140 out of 270 police and 100 coolies, carriers of the sick and dead, out of about 200 died.

It would appear then that, although a large number of deaths might have been prevented by sanitary methods, the duration of the epidemic differed but slightly from that of centers in which modern methods for controlling the epidemic were carried out by a well-organized staff of workers.

Another instance, though very slight in comparison, is that of a village near Peitaiho, south of the Chinese Great Wall. Here a man brought the disease home and died, his family became infected, and they in turn infected their next-door neighbors, so

that seven persons died. The head men of the village then took steps to prevent people entering or leaving the village, with the result that the disease spread no farther. These simple-minded people knew nothing of Western sanitary methods, but acted only on the instincts of fear.

Then followed a second paper on the same subject,

THE SPONTANEOUS DECLINE OF THE EPIDEMIC

By Dr. Stanley

I think the question of the spontaneous decline of the past epidemic, in the absence of preventive measures, is an important one from an administrative point of view.

In a report published some three months ago I ventured the opinion that the outbreak of plague in the north, if it continued mainly pneumonic in form, would be short and sharp, and more easily controlled than bubonic plague dependent on rat infection.

The time the epidemic has lasted in most of the places affected appears to have been roughly the same, independent of the sanitary measures adopted. I take it that sanitary measures have lessened the number of cases of plague but have not markedly limited the duration of the epidemic.

The incidence [of bubonic plague] appears to have declined in Hongkong and Canton synchronously, although sanitary measures were taken against plague in Hongkong, whereas in Canton practically no preventive measures were taken. In Shanghai, also, while preventive measures were taken against plague in the Foreign Settlement, the condition as regards plague does not appear to have been markedly worse in the surrounding community under a native administration characterized by almost complete absence of sanitary control.

In the large European cities the classical methods of prevention—notification, isolation, and disinfection—have not stamped out diseases of comparatively low infectivity, such as, for example, scarlet fever. It would appear that plague is a disease which ought not to spread in communities living under conditions of life where the ordinary rules of sanitation of the dwelling and person are observed.

From these remarks I do not wish it to be understood that I would not advocate active preventive measures against plague, but rather that it is necessary to get the influence of positive and negative sanitation in proper perspective, so as to be in a position to assess the actual value of sanitary work, and to be able to

recommend specific sanitary measures involving an expenditure of public funds commensurate with the ultimate benefit.

The following notes were then read on the subject of

DATA RELATING TO THE ORIGIN OF THE INFECTION IN TIENTSIN

By Dr. J. Chabaneix

In Tientsin the epidemic lasted from the 13th of January to the 11th of March. The number of deaths from plague has been 111. Chinese only have been affected.

Tientsin is an important center consisting of two parts—the foreign concessions and the Chinese city, the latter with about 600,000 inhabitants.

The first case was that of a Chinese merchant who returned from Mukden on the 12th of January and died the next day in the Austrian concession. Thirteen deaths followed in the same concession, which is chiefly occupied by Chinese houses and is contiguous to one of the suburbs of Tientsin city.

In Tientsin city and its suburbs and immediate surroundings there have been 98 deaths from plague.

The infection came from three sources:

1. From one of the contacts with the Austrian concession case.

2. From a coolie coming from Kirin who died on the 13th of January.

3. From a man coming from Tengchow (Shantung) who died on the 24th of January in Tacheku, an important town of 10,000 inhabitants situated on the east bank of the river, close to the Belgian concession.

We have been able to trace the source of infection in nearly all the cases.

From our study, we may note the following points:

1. The disease is liable to attack a great number of those who come near to a plague patient, especially those attending him and speaking to him—for example, parents, relatives, friends, servants, doctors, and nurses. Chow Ho Sen, himself a contact of a plague-infected man coming from Manchuria, has been the cause of the infection of 39 persons, of whom 24 are relatives. The 15 remaining cases are accounted for as follows:

a. A woman (a neighbor) came to attend her friend, caught plague, and infected her husband (2 persons).

b. Another friend came, caught plague, and infected her husband, the father and the mother of her husband, and two maids (6 persons).

c. The medical profession is represented by 3 persons:

(1) A midwife who herself infected her son (2 persons).

(2) A woman doctor who infected her son (2 persons).

(3) The last boy was attended by a Chinese doctor who succumbed and infected two of his sons (3 persons).

2. The epidemic progresses in wave-like curves, the interval between the summits of successive waves being about four days.

3. Both sexes have been equally affected—20 males and 20 females.

4. The age period between 20 and 30 is most liable to infection, the youngest patient being 5 years and the oldest 85 years.

5. The tendency to dispersion of the infection has been very great, nine principal foci having been created, some of them at a distance of 2 to 3 miles from the first focus.

6. There have been 5 passages of the disease in 24 days, making an average of nearly 5 days for each passage (or the interval between infection and death).

The man who came from Tengchow (Shantung) to Tacheku on the 24th of January was the cause of 19 deaths. He infected at first his wife, the Chinese doctor, and a friend. Successively, three daughters and one son died, a man who attended the burial of this family, then his wife, and finally a beggar who was the only one willing to bury the two last plague-infected corpses. The Chinese doctor was living alone in his house, and did not transmit the disease to anyone.

The friend was living at an inn; he infected seven other persons living in the same inn, besides the accountant and a coolie.

The deductions we may draw from this example of dissemination differ but little from those given above for the Austrian concession case. The heavier incidence in males (15 males and 5 females) is due to the fact that the disease broke out in an inn.

NONINFECTIVITY OF MERCHANDISE

Professor SHIBAYAMA. According to the observations already recorded by Drs. Wu, Gray, Kasai, and Professor Zabolotny, the infection in plague pneumonia is attributable, without exception, to contact with infected human beings. Without exception, the first case in each part of the country originated from persons who had introduced the infection from some other neighborhood. The source of infection in each center was perfectly

clear, and it is evident that from this standpoint inanimate objects, such as food, clothing, etc., can be excluded from consideration. From this, the conclusion can be drawn that infection was not spread from place to place by goods or merchandise. The pathological and anatomical alterations found in the lungs also prove that infection generally took place through inhalation of plague bacilli, as has been clearly demonstrated by Professors Strong, Koulecha, and Fujinami, though the primary point of infection in the respiratory tract may vary. If these facts are recognized it is not difficult to solve the problem set for this day's programme. To explain how inanimate objects of different kinds played no part in carrying infection may not be easy, but that they did not might be due to the fact that the plague bacilli in the sputum have small powers of resistance against light and drying and easily lose their infectivity. The bacilli are infective only when they are inhaled in droplets, and infection from dust probably never occurs. On the other hand, it is extremely interesting that in this epidemic, plague pneumonia has been found in donkeys, and the fact that human beings have been infected from donkeys is an especially important point to consider.

INFECTION BY HEALTHY CARRIERS OF THE DISEASE

Dr. CHRISTIE then read the following paper on the case of Mrs. Liu of Kaiyuan, who is said to have infected a number of people with plague without herself contracting the disease.

The following account was taken down as nearly as was possible from a Chinese report.

Mrs. Liu is 27 years of age, married, with no children. She was vaccinated when a child, has never had a serious illness, and has never had any infectious disease.

On the first day of the Chinese year (January 30), Mrs. Liu's husband's brother, who lived with her and her husband in Kaiyuan, was taken ill with headache, his feet and hands soon becoming powerless. Next day he was weak and could neither eat nor drink, and in the afternoon his nose bled profusely. On the 3d of February he was very ill, coughing badly and expectorating blood, and died at 4 p. m. Mrs. Liu and her husband nursed him, sprinkling ashes on the blood and sweeping it away. The body was buried in the snow, but this being reported to the sanitary authorities, it was removed and cremated outside the city.

On the 5th, the husband and another brother went and gathered the ashes and fragments of bones, which they wrapped up and deposited in a temple mortuary. They then went to a black-

smith's shop, where both were taken ill, the husband having serious bleeding at the nose. The blacksmith, much alarmed, sent for Mrs. Liu, and the two sick men were taken home in a cart on the 6th. Next day they were removed to the Plague Hospital, where both died on the 8th.

Mrs. Liu was the only member of the family left, and when the house was shut up on the 7th she was received by a neighbor, Mrs. Kuan. On the 8th, however, Mrs. Kuan also became ill, and died on the 9th, Mrs. Liu attending on her throughout and dressing her for burial.

Mrs. Liu had now been in close contact with four cases of plague, two of whom she had attended until death. She wore no mask, and took no precautions of any kind.

On the night of the 10th, Mrs. Liu became frightened and fled, escaping from the city through a drain under the wall. After wandering about all day, she was taken in at night to the house of a relative called Sun, where another relative called Fu was staying. These men, however, were afraid of the wrath of the other villagers, as, for fear of plague, no stranger was allowed to sleep in the village, which was as yet uninfected. They therefore during the night took her to another village to the home of a man called P'an. She arrived here at dawn on the 12th.

On the 14th Mr. P'an was taken ill, and he and one other of his family died.

Mr. Sun also died and Mr. Fu and three of his household, all these deaths being attributed to contact with Mrs. Liu.

When Mr. P'an was taken ill, Mrs. Liu learned that she was to be taken to a segregation hospital in Kaiyuan, so she again fled and remained hidden for some days in a hut among straw. Finally she was taken in a worn-out condition to the segregation hospital, where she was examined, but no trace of plague was found.

RÉSUMÉ OF CASE OF MRS. LIU OF KAIYUAN

January 30. Mr. Liu's brother taken ill, nursed by Mr. and Mrs. Liu, died February 3 in their house.

Mr. Liu and another brother taken ill, nursed by Mrs. Liu, but removed on 7th to the Plague Hospital, where they died.

Mrs. Liu removed to house of a neighbor, Mrs. Kuan. Mrs. Kuan became ill and died on the 9th, Mrs. Liu attending her to the end.

Mrs. Liu fled from Kaiyuan in the night.

Mrs. Liu stayed the night at the house of Mr. Sun, where Mr. Fu also lived at the time. Mr. Sun afterwards died, and Mr. Fu and three of his family. Their village was not previously infected.

Mrs. Liu early in the morning entered the house of a Mr. P'an.

Mr. P'an was taken ill, and he and one other died. These three men—Fu, Sun, and P'an—are said to have been infected by Mrs. Liu.

Mrs. Liu fled and hid for some days in a hut among straw. She was then taken to the Kaiyuan segregation hospital, but had no trace of plague.

DISCUSSION ON ORIGIN OF INFECTION IN VILLAGES AND TOWNS

Professor Zabolotny said that there were many very important questions relating to the origin and diffusion of the epidemic.

Dr. Iasienski would speak later about plague in Manchuria in previous years, and Dr. Bogucki, who was in Harbin, would speak upon the results of sanitary measures taken there and at Manchouli, Petrofski, and other centers of infection. These measures were extremely important for combating plague, and emphasized the importance of diagnosing the first case and of introducing immediately modern scientific measures to stamp out the infection. Measures for the discovery and surveillance of suspects had a paramount influence upon the extension, intensity, and duration of the epidemic. The declaration of the first cases and immediate preventive measures in accordance with the dictates of modern science were of capital importance.

Then followed the paper upon

THE PLAGUE EPIDEMIC AT HARBIN

By Dr. Bogucki

The first case of plague on the territory of the Chinese Eastern Railway occurred on October 12, 1910, at the station of Manchouli.

At this time the railway traffic was quite unrestricted. There were no medical examinations, no temperature observations, and no quarantine regulations for the passengers leaving the station. The first case of plague occurred at Harbin on the 27th of October. The victim was a Chinese who had arrived from Manchouli.

On the same day, the 27th of October, a programme of anti-plague measures was instituted by the municipal executive committee. This programme consisted of the following items:

1. Establishment of a plague barrack and of isolation and observation wards.
2. Division of the town into eight districts, for the purpose of sanitary control, including the inspection and surveillance of people passing through the town.
3. In connection with the question of disinfection, it was decided to burn articles of small value and to refund to the proprietors a corresponding sum; for articles of greater value two disinfecting rooms had to be put in readiness.
4. Invitation of an adequate medical staff from Russia.
5. The provision of a suitable number of sanitary carts for cleaning the town.

6. Appointment of sanitary officers. Lectures on the plague. Publication of pamphlets in the Chinese language to acquaint the population with the nature of the epidemic.

The town was not prepared to meet the epidemic. A number of effective and rational measures could not be taken in time, and the first cases of plague could not be sufficiently localized and investigated.

On November 12, fresh cases of plague occurred, following the considerable increase of the epidemic in Harbin's suburb, Fuchiatien, about one-half verst [one-third of a mile] distant. The close commercial and industrial connection of these two places was a very important factor in the extension of the disease; the spread of the epidemic in Harbin was directly related to the increase of the plague in Fuchiatien. This is amply illustrated by the curve showing the progress of the epidemic on the chart. The Harbin curve closely follows with a two days' interval the rise and fall of the Fuchiatien curve. [See Plate VIII.]

Harbin is the administrative center of the Chinese Eastern Railway territory. Besides being a large commercial and export center in the Far East, it attracts a vast number of workmen; during last summer about 60,000 arrived, of which only 5,000 were Russians. The rest were Chinese coming from Chefoo and southern Manchuria. They settle down at Harbin in the Chinese quarters in the commercial part of the town, the so-called Pristan, and live mostly in mud-built, dark, dirty houses, with no proper floors and with windows pasted up with paper. Very often the number of persons living in such houses is five to ten times greater than might be supposed, judging from the dimensions of the buildings. Similar conditions prevail throughout the whole town. There are no sewers, no waterworks, no regular system of removal of refuse, and no efficient sanitary precautions for the health of the population, especially as regards the most dangerous factor in connection with the spread of epidemics, namely, Chinese workmen.

The sanitary conditions in the town of Fuchiatien are even worse than those mentioned above. Having increased during the fourteen years the railway has existed from a dozen to three thousand houses, Fuchiatien shelters half of the army of coolies coming to Harbin. Almost all the buildings of this town represent inns, eating houses, opium dens, low-roofed, dirty, half-tumbled-down dwellings swarming with insects and parasites. The quality of food corresponds with the conditions of life. Famine among the unemployed coolies appears regularly every

year. Although opium smoking is prohibited both by the Russian and the Chinese authorities, there are a great many secret opium dens in Fuchiatien as well as in Harbin. During the night these dens are invaded by a large number of coolies, who fill every available space in them. If by chance a plague-infected person gets into such a crowded house the disease is most readily conveyed to the others (as has been proved several times by the night patrols), especially by means of the opium pipe, which passes from mouth to mouth.

Such were the conditions under which the first plague cases appeared in Harbin and Fuchiatien and which fostered the rapid development of the disease in both places. If the ravages of the epidemic in Harbin were not so great as in Fuchiatien (as shown on the chart), the reason for this is to be found solely in the difference between the measures adopted in the two places.

With the increase of the epidemic at Harbin and in the territory of the railway the preventive measures adopted according to the plan elaborated by the municipal executive health committee following the advice of Professor Zabolotny were directed toward—

1. An increase of sanitary vigilance over the health of the population.
2. Location of the plague centers; early discovery and isolation of plague cases.
3. Improvement of home conditions for the poorest working classes.
4. Establishment of night refuges and eating houses for the workmen and unemployed.
5. Establishment of sentry stations for medical inspection of all persons arriving in the town.
6. Careful disinfection of houses and clothes.

The town was divided, first, into eight, and afterwards into sixteen, medical districts. Each district had a staff of one doctor and two or three medical assistants. To them were intrusted the special care for the health of the people and the sanitary organization of the respective districts. Special attention was given to mud houses unfit for habitation and to those houses where plague cases had occurred. Much time was spent and great efforts were made by the district staffs on night raids, patrolling and inspecting inns, eating houses, and opium dens to discover plague cases. The persons who were in contact with the plague cases were sent with a medical assistant and under police escort to observation wards. After bathing and disinfection of their clothes, such persons were detained for five days in railway cars specially adapted for this purpose. Sufficient cars were provided to accommodate 2,500 people.

The majority of plague cases and corpses were found in the

streets, as the inn and opium den keepers expelled the sick and threw the corpses out in the street, as far as possible from their houses. With the further development of the epidemic, sick persons and corpses were found mostly in certain parts of the Chinese quarters, indicating that the centers of infection were to be found in these parts. Therefore, all Chinese living in these parts of the town, after having been registered the day before, were taken to the observation wards. The first evacuation *en masse* of the Chinese was carried out on the morning of December 24, altogether 1,413 persons being removed for observation. On the next day the disinfection of their houses was begun. The disinfection consisted of a plentiful washing and swabbing with a solution of sublimate. Articles of small value were burnt and valuable articles were sent to the disinfection rooms, which were arranged in refrigerator cars. The walls of the disinfected houses were whitewashed and the buildings well ventilated. Chinese houses which were declared to be unfit for habitation were burnt and the assessed value of the destroyed buildings refunded to the owners. Similar measures were adopted for the other infected parts of the town.

This proved to have a most beneficial result. Within fourteen days 46 plague cases were discovered among the people and removed for observation. The sick were at once isolated. If they had remained in the inns and opium dens they might have escaped sanitary control, and would doubtless have created new centers of infection.

During the epidemic from November till February (inclusive) altogether 10,114 persons were passed through observation cars. Out of this number 9,899 were Chinese, and 215 Russians; 180 Chinese and 2 Russians were removed to the plague hospital and 102 Chinese and 7 Russians to the isolation wards.

The average number of days spent in the observation cars by the Chinese suspects was 7.4 days and by the Russian suspects 4.6 days.

The food for the people under observation was supplied gratis by the Antiplague Bureau.

Sixty-four corpses were found in the observation cars. This shows that there were certainly deficiencies in the organization of such a wholesale system of isolation, especially in the first week of its existence. The medical staff was insufficient in number, consisting of 1 doctor, 2 medical students, and 7 medical assistants. The Chinese themselves never helped by pointing out sick persons who were in the same car.

Each car contained from 10 to 25 persons. When a patient

or suspect was discovered in a car he was at once removed to the plague hospital or to the isolation wards. The rest of the inhabitants of the car were removed to other cars.

The largest number of cases in one car was 11. It is difficult to ascertain whether these cases were the result of sickness acquired in the car or whether the disease was contracted in the infected districts from which they were brought.

Plague cases were discovered as follows:

In twelve cars there was 1 case in each.
In seven cars there were 2 cases in each.
In three cars there were 3 cases in each.
In three cars there were 4 cases in each.
In two cars there were 5 cases in each.
In five cars there were 7 cases in each.
In one car there were 8 cases.
In one car there were 10 cases.
In one car there were 11 cases.

In ten cars repeated cases occurred during several days. The interval between the appearance of successive cases did not exceed ten days.

In the town 20 Chinese houses were registered by the district doctors where plague cases (from 2 to 15) had appeared repeatedly by successive infection direct from a plague patient. Cases of this nature were discovered by Dr. Budberg in No. 5 Koreiskaia Street, No. 238 I. Mechanicheskaia Street, No. 19 Torgovaia Street, Nos. 8 and 20 Japonskaia Street, No. 11 Birjevaia Street, in the coolie barracks at Vrooblewsky's distillery, and by Dr. Lebedewa in No. 242 Bazarnaia Street, where during one day 11 sick and 4 corpses were found. The lengthy stay in this house of Dr. Lebedewa, one of the medical assistants, and the interpreter accompanying her, was the cause of their infection with plague.

I shall not dwell on the question of the organization of the plague and isolation barracks, as this subject has been dealt with by Dr. Haffkine in his paper.

Vaccination of all the ranks of the medical staff did not show any practical results. This was very quickly realized by the Russian population of the town, especially after the infection of Dr. Lebedewa (vaccinated once). The people being supported by some of the doctors in their belief as to its inability refused vaccination, and in consequence the vaccination station had to be closed.

Altogether 8,685 vaccinations were made; in 2,560 cases the vaccinations were repeated. Out of twice-vaccinated Europeans 4 of the medical staff contracted the disease, while out of 484 twice-vaccinated coolies (Russian Flour Mills Company) 7 died

from plague. Out of 110 coolies occupied in Dreesin's flour mill 100 were vaccinated and none of them were taken ill, while of the 10 nonvaccinated 2 contracted the disease.

A council of the doctors at Harbin attended also by Professor Zabolotny, after examination of the evidence at hand regarding vaccination in connection with the present plague epidemic, arrived at the conclusion that the results of vaccination for the prevention of plague infection have so far given no proofs of inefficacy and can not shake the importance of vaccination as established by modern science.

On the 28th of October, a medical detachment was organized for the transport of those sick with plague and of corpses, which detachment consisted of 1 doctor, 3 medical assistants, and 10 helpers. With the increase of the epidemic, the staff of this detachment was augmented and consisted of 1 doctor, 10 medical assistants, 52 helpers, 15 drivers, and 11 servants attending to the staff.

At the beginning it often happened that much time was lost while searching for the sick and for corpses, the information regarding the whereabouts of these not always being very accurate. Sometimes three to four hours were spent in searching for a single case, at a temperature of 25° to 30° R. [F. 25° to 35°] below zero. It is clear from this that the work of the detachment was particularly trying and dangerous.

The results of the work of the detachment for the months of November to February are as follows:

Altogether, the detachment turned out 1,095 times and removed 965 sick persons, of which 430 were sent to the plague hospital, 319 to the isolation wards, 208 to the observation stations, and the remainder to the cemetery.

The corpses of persons dead from plague were brought by the detachment to the plague cemetery about 2 versts [about $1\frac{1}{3}$ miles] from the plague hospital.

The council of doctors of the Antiplague Bureau had repeatedly pointed out the desirability of cremating the corpses, while not wishing to offend the religious feelings of the Chinese, who treat their dead with the utmost reverence. This question was solved in the affirmative only after repeated conferences with the Chinese authorities and the chief officers of the Fuchiatien antiplague organization. It was then decided to begin with the cremating of the corpses, both of the recently dead as well as of old corpses which had been buried.

Altogether during February 1,416 corpses were cremated, out of which 1,002 were dug up from the graves. The cremation

was done in brick kilns and partly in special holes blasted in the frozen ground. The majority of the corpses was naked, and this seems to be rather important from an epidemiological point of view, as there is every reason to suppose that the Chinese threw out their corpses in a naked state, keeping the clothes for further personal use.

As the plague cases appeared mostly among the poorest classes of the people, the principal question was how to improve the home conditions of these classes. This was more important as the greater number of houses, inns, and eating houses unfit for use had been either burned or closed. It was necessary, therefore, to provide night refuges and eating houses under medical control for the poorest classes. Such establishments were opened to accommodate 1,800 persons. Everybody coming to the night refuge was allowed to stay there until morning, and received tea and three-quarters of a pound of bread free of charge. For laborers special places (250) were provided at a price of 2 kopecks [$1\frac{1}{5}$ cents United States currency] per night. Annexed to the night refuges a small hospital with eight beds was fixed up with ambulance attached. The beds were continually occupied, 500 patients being received during the first month of the existence of the hospital.

In all the night refuges and during the whole time of the epidemic up to March 15, 61,665 persons were fed and sheltered for the night. About 80 per cent of the whole number of plague cases during the second half of the epidemic in the town was discovered and isolated in time.

Every visitor of the refuge was washed in the bath house, the daily number of bathers being about 200 to 250. Their clothes were disinfected in a "helios" apparatus.

Out of the whole number of plague cases in the town 36.5 per cent was discovered within the town limits, 0.3 per cent in the night refuges, 18.5 per cent in the observation wards, 7.6 per cent at the sentry stations, and 10.7 per cent outside the limits of the town.

Conclusions.—1. In antiplague work, especially when dealing with pneumonic plague, it is of the utmost importance to discover the first case of sickness as soon as possible. Therefore, systematic plague work in towns is only possible when there exists a permanent medical and public-health institution ready to give ambulatory, hospital, and private assistance to the people on a large scale and free of charge.

2. In order to prevent the outbreak of plague epidemics, the town authorities must give special care to the conditions of the

homes of the poorest classes, by providing cheap lodgings and night refuges. For fresh arrivals and the unemployed, places must be provided where they may get food and medical assistance, with bath houses and rooms for disinfection attached. At the same time regulations must be drawn up for keeping the workmen's barracks in a sanitary condition.

3. The Chinese working classes in the town of Harbin, as well as in the suburbs, in trading and industrial establishments and in railway workshops, can not represent a source of danger in connection with the spread of plague if efficient medical control is provided and maintained and if they are lodged in well-built houses.

4. As it is most important at the beginning of an epidemic to have an adequate medical staff ready to give assistance to the people, doctors on permanent duty in hospitals or districts must not be ordered to places where plague or cholera has broken out.

5. In Harbin, as well as in the settlements along the railway line, medical assistance for the Chinese population must be provided for.

6. According to the results of investigation of cases of direct infection from sick persons, the period of incubation does not exceed three days.

7. To insure sanitary control in the populated places of the Chinese Eastern Railway territory, a health department should be established with the requisite number of doctors, health officers, and assistants, so that preventive measures can be taken at once in case of any new outbreak of the disease.

8. For the scientific examination and the accurate recognition of the first cases of plague on its appearance in the railway territory, and for the purpose of epidemiological investigation of the plague epidemics in Manchuria and the Far East, it is necessary to establish at Harbin a bacteriological institute and an epidemiological bureau, on conditions mutually agreed upon with the Chinese Government.

On the proposal of Dr. FARRAR, and in accordance with the wishes of the meeting, the Conference then adjourned.

SESSION XI, APRIL 17

PROGRAMME ARRANGED FOR THE DAY

A. Epidemiology.

6. Has there been a spontaneous decline in the past epidemic—i. e., apart from the influence of preventive measures; and, if the evidence for this exists, what is the cause of the decline (continued).
7. Data relating to the origin of infection in villages and towns.
    a. The importation of persons incubating the disease, or of sick persons, or healthy carriers of the disease (continued).
    b. The importation of infected clothing or merchandise.
9. The infectivity of houses in which one or more plague cases occurred.
    a. Danger from the contamination of floors, *k'angs* [brick beds], food, and vessels for food, etc., by sputum of plague patients.
    b. Have fomites (infected clothing, etc.) played any part in the spread of the epidemic as agents in the spread of infection.
    c. Is dust capable of carrying infection.
    d. Artificial heating of rooms and ventilation or the absence of ventilation of rooms as factors which may influence the infectivity of houses.
    e. The relation of overcrowding and the habits of the people to the spread of the disease within houses.
    f. The duration of infectivity of rooms or houses.
10. The question of variation in virulence of the bacillus at different stages of the past epidemic, as evidenced by the average duration of the illness, by the case mortality, and by the inoculation of animals.
11. Evidence as to natural immunity in persons exposed to infection.

12. The question of the danger of transmission of the infection to rats during the past epidemic.
    a. By the sputum of plague patients.
    b. By gnawing exposed plague corpses.
    c. By fleas and other insects.
    d. By inhalation of plague bacilli.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Discussion on the cause of the decline of the epidemic.
3. Data relating to the origin of infection of towns and villages.
4. Some instances of healthy carriers of the disease, with evidence of its transmission by infected clothing.
5. General discussion of programme.

PRELIMINARY BUSINESS

The meeting opened on Monday at 10 a. m. with Dr. Wu in the chair.

The minutes of the last session were confirmed.

Dr. PETRIE, referring to Professor Kitasato's resolutions passed at the previous session, asked whether rule No. 4, which stated that no one was allowed to speak more than twice upon the same subject in discussions, applied to questions. He thought it was most important that members of the Conference should not be restricted in regard to the questions they were allowed to ask.

The CHAIRMAN said he understood that this rule did not apply to questions.

Dr. ASPLAND said that there was a little matter to which he wished to refer, which he understood would afterwards be brought up in the form of a resolution by one of the Delegates. This was in regard to an article which had appeared in the Manchuria Daily News.

After considerable informal discussion, Dr. FARRAR proposed the following resolution:

"That with reference to a paragraph appearing in the Manchuria Daily News of April 13, it be an instruction to the Secretary to send to that organ a statement, signed on behalf of all the delegations by the editorial committee, that all records of proceedings are drawn up by the Medical Secretary and the editorial committee, who are alone responsible for their contents, and that no official reports of the Conference have been published, and that the editor be requested to insert this letter."

This resolution was adopted *nem. con.*

Dr. IASIENSKI and Dr. CHUNG then each read papers, the former relating particularly to measures employed to combat the epidemic, at the conclusion of which Dr. ASPLAND moved that the contents of these last two papers should be reserved and included in their proper places in the programme. [See pp. 217 and 226.]

Dr. PETRIE seconded this proposal. He said that both these papers were extremely interesting, but they were out of order in the programme at the present time.

The CHAIRMAN said that he took it as the sense of the meeting that these papers, to which they had all listened with so much interest, should be included in the report dealing with the measures adopted for combating the plague. He then declared subsection 6 open for discussion—

THE CAUSE OF THE DECLINE OF THE EPIDEMIC

Dr. FARRAR said that with reference to this subsection the Conference was asked a very definite question, and it appeared to him that they must give a definite answer. He had one or two suggestions to make. It seemed to him that the spontaneous decline of the epidemic, if there had been such, could be attributed to three possible causes—bacteriological, meteorological, and social. With regard to the first point, it was the opinion of the Conference that there had been no spontaneous decline in virulence of the bacillus, and, therefore, any bacteriological cause might be ruled out.

Dr. ASPLAND intervened to say that he thought that Dr. Farrar's deductions were prejudicing the whole question before the Conference had come to the stage when these subjects should be discussed.

Dr. FARRAR stated that he was merely discussing the evidence. The bacteriological cause could be ruled out. There remained the meteorological and social causes. With regard to the former he submitted that the Conference had not before it sufficient data in the form in which it should have them. On the board was shown a very good curve of the epidemic in Fuchiatien. [See Plate VIII.] It was generally conceded that apart from the preventive measures taken, there had been a decline there before these came into full operation. Certainly in Chefoo and several other towns and villages there had been a spontaneous decline apart from preventive measures, because in Chefoo no preventive measures to speak of were taken. With regard to meteorological influences, sufficient data so far had not been presented, but such data ought to be obtained and collated with the curve of the disease. With regard to the influence of social causes apart from preventive work the decline might be due to the people becoming alive to the danger and thus avoiding contact with plague cases, or they might have become educated by means of lectures and notices and so forth. They would have to come to some very definite decision in regard to this question of the spontaneous decline of the epidemic.

Dr. MARTINI thought that this was a very important question, and that the spontaneous decline of the disease ought not to be

taken for granted. From his experience in Shantung Province, he believed that there had not been a spontaneous decline at all, but that the Chinese had learned how to combat the disease. Papers explaining the disease were circulated by the Government, and then the people saw the danger. Moreover, coolies coming home to Shantung knew what had happened in Manchuria and told their relatives not to come into their houses, because if they did so they would become infected and the whole family might die. This advice was never disregarded. If anyone saw a man die of plague he would be very careful in future. It seemed to be a spontaneous decline, but in fact it was not. The Chinese closed the doors of the infected houses by kaoling [clay] and mud wall. Dishes were put on the top of the wall so that the infected persons might obtain food. These measures might seem strange to them, but the practical effect was that further infection immediately stopped in the villages. Further, the village officials did not allow people from infected places to enter their villages. The villages were segregated by strict measures enforced as soon as possible after a plague case occurred. The peasants of the leased German territory of Kiaochow voluntarily protected the whole frontier by means of a cordon along the boundary river Paatscha. No plague cases came into this territory. The inhabitants of this district themselves volunteered the proposal that they should be fined $25 if one case escaped their control. In Shantung Province itself, where, as is well known, there have been from 2,000 to 2,200 plague cases, there were similar instances of the adoption of protective measures by the population, in addition to the excellent measures enforced by the enlightened Government, especially by His Excellency Sun Pao Chi, who did not grudge the necessary soldiers, and the foreign doctors who were put in charge throughout the country. This work was a very important one because it has prevented up to the present the spread of pneumonic plague to the Yangtsze Valley, a part of China which if it had been ravaged by this epidemic would assuredly have been the means of spreading the disease over nearly the entire empire and even, perhaps, into other countries. Therefore, the idea that the decrease of this epidemic was due to a spontaneous decline must be rejected. Quite the opposite was to be believed. It must be assumed that the measures taken by the various Governments and by the people themselves were effective, and they must be encouraged to do, if necessary, the same work in the future.

Dr. ANDREW said that in connection with what Dr. Martini had stated he had had a similar experience in Chinwangtao, where

they had a coolie camp containing about 4,000 coolies. A great number of these coolies were Shantung men who had a number of relations—brothers, cousins, etc.—working in Manchuria. At Chinwangtao, when the Chinese New Year approached, it was fully expected that the place would be infected by these people coming south and stopping at Chinwangtao with their relatives. As a rule 15 to 20 of these men came south from Manchuria every month. From the time the epidemic started, the local magistrate did everything in his power by conferring with the contractors and also by placing police scouts to watch every road. It was known for a certainty that from the time the epidemic began not a single Manchurian coolie entered Chinwangtao. The health authorities had merely made suggestions to the local magistrate, and he had done everything he could to prevent the ingress of the coolies from Manchuria, and to get the people of the town to agree to these measures.

Dr. Broquet said that he quite agreed with the conclusions of Dr. Martini. He considered that the Conference should express the opinion that the epidemic so strenuously combated was brought to an end simply by the very effective measures taken both by the Government and by the people. In the former epidemic that occurred in the fourteenth century in Europe there was no marked sign of the epidemic decreasing surely and sharply as in the present case. It was useless to search for other causes.

Professor Zabolotny said that the history of the epidemic as a whole proved that it consisted of a succession of minor epidemics. When the epidemic in Manchouli was finished a fresh one broke out at Harbin. It must be noted that the meteorological conditions were almost the same in every case. He quite agreed with Dr. Martini and Dr. Broquet that the measures taken exercised a great influence upon the decline of the epidemic, and that, as several epidemics had taken place under the same meteorological conditions, it must be granted that they could have been checked only by the measures taken to combat them. He produced a chart showing the daily death rate from plague in various places. [See Plates VIII, IX, and X.]

Professor Kitasato said that he did not consider it possible that there could have been a spontaneous decline in the epidemic apart from the measures taken. Dairen was a very good example. The first cases occurred in Dairen in January. Within one month pneumonic plague was stamped out there, while the epidemic then commenced in other places throughout the whole of Manchuria. He considered that if these measures had not been taken at Dairen the epidemic would certainly have in-

creased, but by means of the very strict measures taken the Japanese had succeeded in stamping out the plague. He had come to the conclusion that drastic preventive measures must be employed. They knew now the mode of infection in plague pneumonia, and, therefore, it must be fought with scientific weapons, and a spontaneous decline of the epidemic should never be anticipated.

Dr. GRAY said that he agreed to a great extent with Dr. Martini and Professor Kitasato, but in India, according to a paper read about a year previously at the Society of Tropical Medicine in London on the subject of pneumonic epidemics, it was a rather significant fact that all the small pneumonic epidemics occurred from October to March, and, so far as he recollected, there had never been any sign in India of a pneumonic outbreak arising after the first of April or during the whole of the summer. The author of this paper gave some instances where outbreaks of plague pneumonia arose in villages which had not previously been affected by any form of plague. After lasting for about three months, in almost every instance these outbreaks developed from April onward into bubonic plague.

Dr. LEWIS said that there was one point he would like to make with regard to comparisons between plague in Manchuria and in Chihli. In the first place, at the beginning of the epidemic in Manchuria there was no opportunity of learning about its prevention, but when it appeared in the south the experience of the north was available. Pamphlets were prepared and scattered throughout the country. As soon as a plague case was introduced the people had some idea as to how to deal with it, and he thought that this was the very reason why the same kind of epidemic had not occurred in Chihli as in Manchuria. A man had come there from Manchuria, and from him alone, before the people knew that he had a contagious disease, twenty others were infected. As soon as the people discovered that the disease was plague, they all avoided contact. From the second outbreak of cases not more than four persons were infected. From the third outbreak no cases of infection arose. As soon as the people knew that they had contracted plague they warned others to keep away from them. He thought that the education of the people by telling them how to take care of themselves was a very important thing indeed.

Dr. CHABANEIX. I think it should be remembered that Tientsin is an agglomeration of more than half a million of inhabitants, and that an outbreak limited to 100 cases occurred there from January 13 to March 11, at the time that plague was raging in Manchuria. It seems, therefore, that antiplague measures

have had a great influence in the restriction and stamping out of the epidemic.

Dr. Broquet said that it was well known that the recent epidemic had carried off over 50,000 victims. He thought that if a similar epidemic were to break out now, when the sanitary service was so well organized, it would not be followed by such terrible ravages as there had been at Fuchiatien, for example, before proper sanitary arrangements had been organized. One could not forget that in the epidemic of the fourteenth century there were 25,000,000 victims.

Dr. Petrie thought that the discussion was taking rather a wrong line. The question was not really whether or not preventive measures helped to stamp out the epidemic. No one could doubt that. It was whether, apart from preventive measures, there was any evidence of a spontaneous decline. He did not think that any facts had been brought forward in the discussion disproving this possibility. Dr. Gray had referred to the winter outbreaks of pneumonic plague in India. Then there was the case of Alexandria, mentioned by Gotschlich, where pneumonic plague was prevalent in the winter and was followed by bubonic plague in the summer. He thought it was very important to obtain meteorological evidence, as Dr. Farrar had suggested, to discover whether there might be some correlation between the meteorological data and the decline of the epidemic. In India there were enormous numbers of bubonic cases, with a small percentage of the pneumonic type, but there appeared to be no tendency for the disease to spread widely from the potential foci of pneumonic infection. This might be due to climatic causes or influences. It could not be denied in the least that preventive measures were very important, but it was also important to ascertain whether meteorological conditions exercised any influence upon the epidemic. He had heard Dr. Gibb, a very able observer who had done a great deal of work in the Fuchiatien epidemic, express the opinion that the decline in the epidemic there had begun before any of the preventive measures put into operation could have had any effect.

Dr. Strong said that he would like to ask Dr. Petrie at what season of the year the epidemic of pneumonic plague in Cashmere, reported by Mitra, which carried off 1,374 persons in 1903–4 occurred. Speaking about the effect of the temperature upon the present epidemic, he thought that while directly it might not have exerted any action, indirectly it might have. For example, in very cold weather the people naturally huddled together in their houses, and would not go out so much. Also,

if there were a case of pneumonic plague in a house, the inmates were not likely to turn the individual out into the streets when the thermometer was many degrees below zero. It must be remembered that in some of the smaller villages, where no sanitary measures were taken, the people appeared to have limited the epidemic themselves. No doubt, as Dr. Martini had said, the people became aware of the danger of pneumonic plague, and kept away from cases of it, or isolated those who had developed the disease. He thought that the temperature might have something to do with the decline of the epidemic in those places where no sanitary measures were carried out. Of course, sanitary measures had the most important influence. Only by them could epidemics be prevented. But temperature would exercise some influence. The plague bacillus lives for long periods of time in frozen sputum, but if the weather becomes warm the sputum soon dries, and hence the plague bacillus dies. Other influences might also have played a part in limiting the epidemic.

Dr. FARRAR said that he was afraid that he had created a wrong impression in Dr. Martini's mind, since he apparently thought that he (Dr. Farrar) deprecated sanitary measures. Nothing had been further from his mind. He merely wished to point out that the Conference had to give some answer to the definite question formulated in the programme. He believed that there had been some tendency to spontaneous decline, perhaps meteorological, perhaps social. But these meteorological or social influences ought to be studied to ascertain whether they played a really important part.

Professor GALEOTTI said that he thought that Dr. Petrie had put the question in the proper form. No one could deny that sanitary measures were of the greatest possible importance in a plague epidemic, especially at the outset, in order to control the intensity of the epidemic which was about to develop. But no one could deny either that in every epidemic some meteorological and climatic influences were at work. The decline of the epidemic, in particular, depended chiefly upon these little-known epidemiological factors. In India the plague epidemics always followed a definite seasonal cycle which was very closely connected with meteorological conditions. The sanitary precautions taken were always the same, but the plague mortality rose only in the winter. At the beginning of spring the mortality began suddenly to diminish. Meteorological conditions and other epidemiological factors were also of great importance in connection with the sudden decline of the epidemic in Manchuria.

Professor KITASATO said that he would like to compare the

question of pneumonic plague with that of bubonic plague. In Japan, in January and February, the coldest months, only a few cases of bubonic plague occurred, notwithstanding the fact that there was an extensive epizoötic among rats at that time. It was only in the springtime, or in the summer and the autumn, that the rats entered the houses of the people; in the winter they remained in their holes. In Japan the epidemics of bubonic plague generally began in the month of September, and most cases occurred in November and December; in January the epidemic declined, and in February the country was almost free from plague. In March and April there was a recrudescence, coinciding with the time at which the rats entered the houses. Not only climatic and meteorological factors must be considered, but also the question of the association with rats. In Manchuria, after the epidemic of plague pneumonia ceased, similar considerations might arise.

Dr. Hill said that he had a little positive evidence from the reports he had received. The spontaneous cessation of the disease could well be accounted for, simply by its having killed or frightened away contacts. Allowing only two contacts to each case the death rate in six weeks would be 200, in seven weeks 800 a day, as the result of infection from one man. Since contacts were most commonly persons who nursed or slept in the same room with the patient, the bulk of them were drawn from one social class. Such a death rate would very quickly thin out this class or frighten them away from patients, and thus end the epidemic locally. On the other hand, the duration of the epidemic in different localities had varied from five weeks to four months; the maxima had not synchronized, nor had the dates of termination of infection been the same, but had been separated by two months or more. He believed that the duration of the disease was solely a matter of the removal of contacts by quarantine, fright, or death. Seasonal effect might occur, but would only influence places affected at the end of winter.

Professor Zabolotny showed a chart on which were marked the mortality at various places in the Russian Railway zone, the relative humidity, temperature, and barometric pressure. The conclusions drawn from inspecting this chart were that throughout the epidemics the barometric pressure and temperature had practically been the same, and that since, at the end of the epidemic at Harbin, 80 per cent of the sick was discovered in isolation camps, it must be regarded as established beyond doubt that the preventive measures taken had the greatest influence upon the general trend of the epidemic. From a map of

Harbin he showed the localities in which cases were found at the beginning and at the end of the epidemic.

Dr. PETRIE, in reply to a previous question from Dr. Strong, stated that he was sorry but he had forgotten the season of the year when the pneumonic-plague epidemic occurred in Cashmere. It would be interesting to know.

Dr. GRAY asked if it were not very suggestive that in Harbin, where preventive measures were in working order about a month before those at Fuchiatien, the epidemic curves [see Plate VIII] practically coincided in point of time.

Professor ZABOLOTNY, in reply to Dr. Gray, said that measures at both these places were taken about the same time. There was an interval of not more than three weeks between them. The temperature was the same, but the conditions of life were not quite the same, and this might account for the fact that the smaller town had shown a high rate of mortality, whereas the larger town, where conditions were better, gave a lower rate of mortality. [See Plate X.]

The Conference then proceeded to discuss the data relating to the origin of infection in villages and towns.

DATA RELATING TO THE ORIGIN OF INFECTION OF TOWNS AND VILLAGES

By Dr. IASIENSKI

Before describing the outbreak and spread of the plague in the territory of the Chinese Eastern Railway, I will take the liberty of saying a few words on the appearance of plague in general on this railway during the period of its construction and working—that is, from 1897 until 1910.

The plague made its appearance for the first time in 1899. The infection was brought to Yingkow station from the native town of the same name, in which latter place the first cases were discovered in July of the same year by Dr. Daly, an English physician. The number of deaths in the Russian settlement was small—15 altogether, out of which 6 were Russian. However, in the Chinese town a considerable number of victims was claimed by the disease; during four months, according to official, probably underestimated, statements, there were 1,370 deaths. The disease was mostly of the bubonic form, but there occurred also several cases of pneumonic plague. Notwithstanding the impossibility for both the railway administration and the international sanitary committee at Newchwang to take energetic measures against the extension of the disease from the native town into the neighborhood, there was no considerable spread of the epidemic, which infected only a few villages nearby and the

neighboring town of Kaichow. Regarding the origin of the plague at Newchwang, old local residents—as, for instance, Dr. Daly, who had lived in Newchwang for more than ten years, and Dr. Christie, with more than fifteen years' experience at Mukden—declared it to have been brought from Hongkong. According to their very accurate information, there had been no case of plague for at least fifteen years before 1899.

As the disinfection of the plague-infected places was by no means complete it might have been expected that the disease would reappear next spring, but there was not a single case in spring, summer, nor autumn. The next cases occurred after more than eighteen months had elapsed—that is, in August, 1901. This time there were not so many victims as in the first outbreak, and up to the middle of January, 1902, when the disease disappeared, there were only 114 deaths in the town and 5 deaths in the neighboring villages.

In September of the same year, 1902, the first cases of plague in the town of Kaichow appeared, and afterwards in the vicinity of Tashihchiao, where there was a considerable death roll. The exact number of cases has not been ascertained, but, generally, the number in 1902 was far greater than in 1901. During this period 9 deaths occurred in Yingkow town.

In 1903 there were small outbreaks of the plague in Yingkow town and in a village 17 versts [$11\frac{1}{3}$ miles] from Hsinyuchen station. Just as during the preceding years, there was no spread of the plague north and south despite the considerable traffic which developed on the railway in 1903. The line was opened for regular traffic on the 1st of July. Preventive measures against the spread of the disease consisted only of medical inspection of the passengers boarding the trains at Yingkow station and of those en route when passing large stations.

I have no information whether there were any new local outbreaks of plague in 1904 and during the following years, as the medical control over this part of the country was taken over by our Japanese colleagues, who might be able to enlighten us on this subject.

From 1905 the plague began to threaten the railway from the north at the stations of Manchouli and Chalainor. The first case of bubonic plague was registered in the settlement near the Chalainor collieries in August, 1905. This settlement, containing only 27 mud huts, was inhabited solely by Russian workmen and their families, who came here from the trans-Baikal district to earn their living. There was, however, no considerable spread of the disease either here or at the settlement at Manchouli station. The number of deaths at the Chalainor settlement was

only 13, at the Manchouli settlement only 2. The cases were without exception of the bubonic form, and out of the 15 cases there was 1 case of recovery. The presence of plague microbes was bacteriologically established. It is probable that any further progress of the disease was checked by the vigorous measures taken by the administration. As soon as it was ascertained that the plague had made its appearance, every inhabitant of the Chalainor settlement was taken to the bath house, thoroughly washed, clothed in clean underlinen and outer clothes, and detained for ten days under observation in railway cars. The settlement together with all the property of its inhabitants was burned down, as was also the barrack at the Manchouli hospital, where a death from plague had occurred.

With regard to the question whence and how the plague was brought to those places, it may be asserted with considerable confidence that the disease in 1905, as well as in the following years, was brought about by sick tarbagans. As the question of infection by tarbagans has already been dealt with in the Conference, I shall not say anything more about it and shall proceed to note the further appearance of the plague in the railway zone.

In the next year, 1906, a Cossack was taken ill with plague and died within two days at the Abagaitui settlement, 30 versts [about 20 miles] from Manchouli station. There are reasons to believe that he was infected by sick tarbagans, as he had skinned some of these animals while hunting them on the plains. Soon afterwards there appeared some further cases, altogether 6 in this settlement and 2 in the Manchouli settlement, to which place the disease was brought from Abagaitui. Bacteriological examination proved the sickness to be pneumonic plague. The effective measures taken for isolation and disinfection soon stopped further progress of the disease at these places, the last case occurring on the 24th of October.

In 1907 there were no cases of plague either at Manchouli or in the railway territory in general, although, according to information received, several cases were registered in the trans-Baikal district. At the time of this outbreak it was established that at the stations Haranor, Sharasun, and others, where plague cases had occurred, tarbagans had died in large numbers, and that all the cases were closely connected with tarbagan trapping.

The same conditions appeared in 1908. During this year there was not a single case of plague in the railway territory, but the disease appeared in Mongolia, and was brought thence to the trans-Baikal district, claiming here several victims during this year as well as in the previous year.

In 1909 no case of plague occurred in the railway zone, neither is there any information on hand regarding the appearance of the epidemic in either Mongolia or the trans-Baikal district.

Careful examination of the materials available has shown that, with very rare exceptions during all the years referred to above, we had to deal with the bubonic form of plague only.

In the autumn of 1910 the plague in its pneumonic form broke out at Manchouli station, soon reaching colossal proportions, both in regard to the area affected and to the number of victims. The beginning of the epidemic at Manchouli station is officially dated from the 13th of October, but there are many reasons to suppose that the disease appeared about one month earlier—that is, in the middle of September.

The presence of pneumonic plague was established by bacteriological examination and by section of the first victims.

After a week had elapsed, the first case appeared at Chalainor, the station nearest to Manchouli.

The plague had already made its appearance in summer on the vast plains surrounding the stations of Manchouli and Chalainor upon which, during the summer and autumn of 1910, over 12,000 tarbagan hunters gathered. These districts formed the centers from which by railroad, carts, and pedestrians the plague gradually entered into every part of Manchuria, establishing new centers of infection in the larger places, such as Tsitsihar, Hailar, Harbin, and Fuchiatien, and in the Kwantung [1] territory. In my opinion, one of the principal reasons for so considerable a spread of the epidemic is to be sought in the increase of the tarbagan trapping caused by the unusual rise in the price of the skins. During the last few years the price of one skin has gone up from 20 kopecks [about $0.12 United States currency] to 1 ruble 20 kopecks [about $0.72 United States currency] and more.

The first plague-sick passenger was discovered on October 20 at Chalantun station. He was at once completely isolated and died without transmitting the infection to any of those who were in more or less close contact with him. None of his fellow-passengers traveling in the same car were found to be infected, and, therefore, they were released after five days' observation.

The next cases were discovered on the 27th at Hailar station, on the 29th at Puhudu station, and on the 27th at Harbin. In addition, plague-sick passengers were found in a train at Turchiha station. The car containing the sick and others who were in contact with them was returned to Chalantun, where four died. After this, during the whole of November and almost up to the

[1] Called also Shengking, Fengtien, or Liaotung Province.—[EDITOR.]

end of December, the western branch of the railway up to Harbin, with the exception of the stations Manchouli and Chalainor, was free from plague.

During December the epidemic at Harbin and Fuchiatien gradually increased, and at the same time cases of sickness began to appear on the southern, eastern, and western branches of the railway (Tuichingshan and Mankou). However, owing to the measures taken (which will be dealt with below), the disease appeared in the settlements on the southern and eastern branches in single instances only, although some of these settlements had a population of over a thousand. Altogether there were 78 cases of plague in all the stations and settlements on the railway, with the exception of Manchouli, Chalainor, and Harbin. This number, however, does not include the corpses thrown out by the Chinese into the territory of the railway. Out of 70 stations of the Chinese Eastern Railway, 12 stations were infected with plague; 4 of these were on the western branch, 3 on the eastern, and 5 on the southern branch.

The measures adopted by the Chinese Eastern Railway administration were directed toward achieving two purposes: First, the stamping out of the disease wherever it had already appeared, and, secondly, the prevention of the spread of the plague along the railway line, especially into the neighboring Primorski and trans-Baikal districts. The most vigorous battle had to be fought by the railway administration at the stations of Manchouli and Chalainor, and finally at Harbin. At this latter place a considerable part of the work was done by the municipal authorities.

How the work was carried on at Harbin has already been explained by Dr. Bogucki; I shall deal therefore only briefly with the measures taken at the stations Manchouli and Chalainor, as well as at the other stations where plague had appeared.

The whole antiplague work at Manchouli may be divided into two periods. During the first of these, lasting from October 13 till November 12, the epidemic was fought in the settlement itself. In the second period, when all the inhabitants of the settlement liable to be infected (that is to say, almost the whole of the Chinese population) were removed from the settlement and put into railway cars, the antiplague work was continued in the cars.

In the first period the main efforts, besides striving to bring about and to maintain sanitary conditions in the settlement, were directed toward quick discovery of the plague stricken, their removal to the hospital improvised in railway cars, isolation

without delay (also in railway cars) of all persons who were in contact with the sick, and disinfection of the houses and clothes of the sick and of the contacts. However, these measures proved to be insufficient, as the epidemic had already firmly established itself in many places at the time when the first cases were discovered. A daily inspection of the whole population in the settlement was impossible as the Chinese often hid not only their sick but even corpses. Accordingly, it was found necessary to adopt stronger measures—namely, to remove the inhabitants of the most suspicious buildings and to place them under observation in railway cars. The epidemic did not decrease, however, and at night time dying Chinese were thrust into the streets and corpses were found in waste places and in empty buildings. It was then decided to remove from the settlement all the Chinese, with the exception of a few families living in sufficiently healthy conditions, and to put them into railway cars, where they were under continuous medical control. Altogether 3,238 persons were thus lodged in cars.

This having been done, the antiplague work consisted of inspection twice a day of the whole population of the cars, taking the temperature of suspects, isolating them in special buildings, isolating persons in contact with plague patients, and detaining them under observation for five days. The cars where plague-sick people were found were thoroughly disinfected.

The work in the settlement during the second period consisted of destruction of the centers of infection, thorough disinfection of the buildings which could be disinfected, burning those the value of which was less than the cost of disinfection, and, lastly, in taking off the roofs and thus rendering buildings uninhabitable after disinfection, where the result of such disinfection was doubtful. After the people had been removed from the infected settlement and all necessary measures had been taken to insure immediate discovery and isolation of the sick, the epidemic was quickly subdued.

The second period lasted only eighteen days. During this time all Chinese who had undergone five days' (and sometimes longer) observation were sent once more to the bath house; their clothes were then thoroughly disinfected by steam in refrigerator cars specially adapted for this purpose. When this was done they were sent away in batches of 200 to 400 to Kuanchengtze or Tsitsihar. This was done especially in the case of idle Chinese who had no work and did not know any trade. The rest were gradually released and returned to the settlement as soon as their houses were cleaned. Altogether 77 houses in the settlement

were disinfected. The efficiency of the disinfection appears to be proved by the fact that not a single case appeared in these buildings after the inhabitants were allowed to reoccupy them. Altogether 1,355 Chinese were sent away after observation to Kuanchengtze or Tsitsihar.

Measures of the same character were adopted in the settlement at the Chalainor collieries, with the exception that from the first day when the presence of plague was discovered the whole of the Chinese population was placed under observation at once. The sick were conveyed to the hospital as soon as discovered and the persons who had been in contact with the sick were confined in special buildings (not in cars), of which there were a sufficient number in the settlement.

At the other stations the fight with the plague presented no difficulties, if the first case was discovered in time. The patient was at once put into a car or taken to the plague hospital, such hospitals having been established at all the large stations. The persons who had been in contact with the sick were isolated in cars or in special barracks, and the number of victims at each of the infected stations did not exceed one or two. This seems to prove the great importance in antiplague work of timely isolation of the sick. The stations Tuichingshan and Kuanchengtze were exceptions to the general rule. The numerous cases and lengthy stay of the plague in the former station may be explained by the continual influx of sick from the surrounding infected villages, in the latter by its proximity to the town of Kuanchengtze.

When the first cases of plague were discovered at Manchouli station, measures were taken at once not only to check the disease locally but also to prevent the spread of the epidemic along the line of the railway. These measures were based on the experience gained during the last epidemic at Odessa and during the epidemics of former years, of which there were five on the railway during the period of 1899 to 1910. The rules for dealing with the plague on railways issued by the antiplague committee were followed. At the beginning, these measures consisted only in medical inspection of the passengers at the large stations—that is to say, every 120 to 130 versts [about 80 to 86 miles]. This precaution, however, soon proved to be inadequate for dealing with the epidemic. Sick persons were discovered on the trains, and the disease threatened to spread along the line. Therefore, five days' quarantine for all Chinese passengers leaving Manchouli station was established. The same was done at Chalainor station. Before entering the quarantine, every Chinese was sent to

the bath house, his clothes and luggage were disinfected by steam, and to prevent any possibility of evading quarantine the sale of tickets was stopped at the stations between Manchouli and Hailar. Later on when the plague broke out at Hailar also a similar quarantine was established at this station, and the sale of tickets stopped on all stations up to Mientuho.

Such were the preventive measures up to the moment when the plague began its ravages in Harbin and Fuchiatien. With the increase of the epidemic at these places the question arose whether it was advisable to establish a five-day quarantine with disinfection of luggage and clothes for the Chinese passengers leaving Harbin by railway. It was decided not to do this. Not only were there great difficulties in organizing a regular quarantine system for several hundreds of Chinese passengers leaving Harbin daily, but this measure would have been to no purpose, as anybody wishing to leave for Shuangchengfu, Ashihoh, or even Kuanchengtze without undergoing a five-day quarantine at the station could do so by simply hiring a cart. Therefore, it was decided to abstain from a quarantine system and to subject Chinese passengers leaving Harbin to the taking of the temperature only.

However, the epidemic continued to extend in Manchuria and was brought to Kuanchengtze. It had already appeared on the South Manchuria Railway at Mukden and Dalny. Orders were then given to stop altogether the sale of third- and fourth-class tickets to Chinese passengers.

Shortly before this measure was introduced, steps were also taken to prevent the plague being carried into the Primorski district, a request to that effect having been received from the Vladivostock and Habarovsk authorities.

1. Chinese laborers were not allowed to enter this district at all.
2. Chinese officials and merchants had to undergo a five-day quarantine at Pogranichnaia station before being allowed to enter the district.
3. Passengers arriving in the mixed trains of the Chinese Eastern Railway were transferred at Pogranichnaia into other trains.
4. Articles, such as worn clothes, human hair, and others, as enumerated in No. 5 of "Ordinances and Decrees of the Government" for 1909, forwarded as goods, slow or fast, were to be disinfected.
5. The same articles, if sent by parcel post, were also to be disinfected.
6. The outer covers of mail bags and parcels of the Chinese mail passing through Pogranichnaia for transit to Razdolnoe, Novokiewsk, and Hunchun were to be disinfected.

Further steps were taken to prevent the introduction of the disease by goods and by mail. Temporary quarantine stations were established on the stations Manchouli, Chalainor, Hailar,

Tsitsihar, Shuangchengfu, Taolaichao, Kuanchengtze, Imienpo (for the workmen in the timber concession), and at Pogranichnaia.

Taken together, the above-enumerated measures furnish a picture of the whole work undertaken by the railway administration in order to check further progress of the plague, and I have to add only a few words regarding the parties sent out along the southern, eastern, and western branches of the railway to search the country for infected places and for corpses. These parties consisted of Russian and Chinese doctors, as well as of railway agents, and they collected all available information concerning the whole progress of the plague, the first and last cases, and the disposal of corpses. The corpses discovered by these search parties were at once cremated or buried at a sufficient depth.

Conclusions.—1. As tarbagan trapping may be considered the primary source of infection in all the epidemics in northern Manchuria and in the trans-Baikal district, it seems to be of the utmost importance not only to investigate the disease itself but to introduce at the same time the strictest measures for the control and regulation of the tarbagan-trapping industry.

2. As sanitary improvements on a large scale may be impossible in Manchuria and in the trans-Baikal district, owing to local economic and social conditions, it is necessary to provide at an early date at least for the most important—namely, the improvement of the housing conditions for the poorest classes of the population—by establishing night refuges in the larger centers of Manchuria and the trans-Baikal district.

3. Early discovery of the sick and immediate isolation of persons in contact with them have given very good results during the last epidemic. Where the discovery of the sick in their own houses is attended with difficulties, no effort nor expense must be spared to remove the people from the houses into special segregation camps or into railway cars.

4. Although the establishment of military cordons around the infected towns and villages may be evaded on account of its interference with the liberty of movement of the people, and, therefore, does not always fulfil its purpose—namely, preventing the escape of sick people from infected places—still it is necessary in the present conditions of life in Manchuria to maintain this measure, especially for small places where it involves fewer hardships, and is, therefore, more effective.

5. Medical inspection of the passengers before allowing them to enter the trains, even if most thoroughly done and accompanied

by the taking of temperature, does not guarantee that they will not carry the plague farther on by railway. Therefore it is necessary to establish quarantine at the stations near large towns, with a five-day observation and disinfection of luggage as well as bathing of the passengers in proper bath houses. To prevent evasion of the quarantine, the sale of tickets at the nearest stations must be stopped.

Then followed a paper on

SOME INSTANCES OF HEALTHY CARRIERS OF THE DISEASE, WITH EVIDENCE OF ITS TRANSMISSION BY INFECTED CLOTHING

By Dr. M. S. Chung

The evidence of the occurrence of healthy carriers of the disease in this epidemic is not final, but the examples cited below have either been recorded by trustworthy, Western-educated doctors, both foreign and Chinese, or have been personally observed by the author.

1. In the city of Hulan five men who died of plague were reported to have caught the infection from two apparently healthy women in a brothel. These two women died two days after infecting the men; it is probable that they infected the latter during the incubation period, although it might be said that the universal opinion appears to be that the infective stage of the disease begins only with the cough; for example, there is the case of the Japanese doctor, who died in Hsinminfu, who mixed freely with other people until the onset of symptoms, without apparently communicating infection to them.

2. The case of Mrs. Liu has been recorded already by Dr. Christie [see p. 198].

With reference to infection from clothing, the following cases may be cited:

1. The most notable of these is the one reported by Dr. Wu from Shuangchengfu. A fine fur coat was placed on the counter of the largest pawnshop in the city by a customer. The man behind the counter, a well-educated and trustworthy employee, who handled the fur coat died on February 15—i. e., five days later. Soon afterwards another employee died, and later on another, until altogether 35 out of a household of 60 had succumbed, including the proprietor, who was regarded as the local millionaire. The last death occurred on February 27. In this case there could have been little doubt that the first infection came from the coat. The house where the epidemic spread belonged to the richest family in the city. The block of buildings

they lived in was situated inside a large compound, covering a very large area of ground. It is interesting to note that even the policeman who stood guard over the pawnshop died.

2. Dr. Christie has also reported a case in Hsinminfu where a corpse was deprived of its clothing and where apparently infection was carried by the clothing. A whole household consisting of 8 people died in the course of one week.

3. Again, a quilt bought cheaply in a second-hand clothing shop appeared to infect a household of ten persons in Fakumen.

On the other hand, it should be noted that there are instances where people have been exposed to apparently infected clothing and have escaped infection. Thus, there were two cases where thieves had stolen clothing and pawned it, and later on died, but the pawnshops were not infected.

4. Again, from Chefoo, Dr. Gulowsen reported that he had frequently seen men sleeping in the same beds and using the same bedding as those who had died of plague, without becoming infected.

In conclusion, there have not been reported any cases of infection from such inanimate objects as coins and bank notes.

DISCUSSION

The CHAIRMAN remarked that the question of infected clothing was so important that it ought to be discussed very thoroughly.

Dr. FARRAR said that he did not think that they could accept the evidence in regard to infection by clothing in a pawnbroker's shop, quoted by Dr. Chung, because there had been no evidence to show that the pawnbroker was not infected by the person who brought the clothing. Unless there were very definite evidence that clothes, apart from persons, conveyed infection, they could not accept such instances as those that had been given.

Professor KITASATO asked Dr. Christie whether the Mrs. Liu he had spoken about as a carrier of plague bacilli had had plague at any time.

Dr. CHRISTIE stated that he had suggested that there was a possibility of her carrying plague bacilli without having had the disease herself.

Dr. STRONG said that it was very unfortunate that they had not been able to get some bacteriological evidence about the plague carriers mentioned in connection with this epidemic. In former epidemics of bubonic plague in which secondary pneumonic plague infection had occurred the organism sometimes remained present for a considerable period of time in the sputum. In a case reported by the German Plague Commission the bacilli were

found in the sputum for ten days, but had disappeared by sixteen days. In another case reported from Egypt virulent plague bacilli had been stated to be present in the sputum of a plague convalescent for weeks and months. During this epidemic all the cases which he had seen with plague bacilli in their sputum died within three or four days.

Dr. MARTINI. There was a case mentioned by Gotschlich at Alexandria where the bacilli persisted for seventy-six days.

Dr. STRONG. I understand that there will be an opportunity for me to examine the sputum of a supposed plague bacilli [1] carrier to-morrow.

Professor KITASATO said that the sputum of Mrs. Liu [a supposed bacilli carrier] had been examined twice, and had given a negative result. A serum test had also been made twice, with negative results also.

Dr. CH'UAN. The day before the old plague hospital was burnt, Ku, Chin, and four servants were examined, cultures being made from their throats and clothing, but no plague bacilli were found.

Dr. CHRISTIE said that the question whether merchandise could carry infection was a most important one. It had a most important bearing upon commerce and ought not to be passed over lightly. He did not think that any evidence had been produced to show that merchandise had carried the infection during the recent epidemic.

Dr. LEWIS said that he thought that this section also had an important bearing upon the question of disinfecting and fumigating houses and articles used by the people. He remembered a case in point where people slept in a house two nights after a dead body had been carried out, and no infection was conveyed to any of these people. There were numbers of cases in which people had slept in the same beds, and worn the same clothing as plague patients, without being infected at all. So that while he continued with the fumigation of houses, these cases had made him feel that it was almost unnecessary work.

Dr. ANDREW said that he desired to corroborate what Dr. Christie had said about the importance of the question of infection being carried by merchandise. He could speak with feeling because during the winter time no goods of any kind, coming off ships from Chinwangtao, were allowed to leave the station, and then only in covered cars, until he had issued a certificate that they were free from plague infection. Evidently the authorities got the impression that plague could be carried by merchandise,

[1] The sputum of this case was found to be negative for plague bacilli and was not infective for guinea pigs by the cutaneous method.—[EDITOR.]

and later in the proceedings of the Conference some definite statement upon this point should be made.

The CHAIRMAN asked if there was any evidence about the contamination of floors, *k'angs* [brick beds], food, and vessels for food by the sputum of plague patients.

Dr. BROQUET said that he had made experiments upon this point four days previously. He had given four mice food mixed with the sputum of plague patients, and of the four mice one had died. The mouse was certainly infected from eating a mixture of food and sputum. Therefore it was possible that rats which had eaten rice off a floor upon which plague patients had expectorated might become infected and transmit the infection.

Dr. GRAY referred to what might almost be called the national custom of promiscuous spitting in every house.

Dr. STRONG said that it was well known that the organisms would live in frozen and moist sputum for very long periods: as long as the sputum did not become dry it might be considered infective. Evidence had already been given regarding the length of time the plague bacillus would live in frozen sputum.

Dr. GRAY mentioned the case of the carters at Liaoyang. A man had handled a bundle of clothing and ropes round a dead body and had died of plague.

Dr. CHRISTIE stated that there were a number of cases of this kind, but they could not be regarded as conclusive. There was one case recorded where a farmer who was traveling along a road saw a dead body clothed in a good fur coat. He dismounted, took away the fur coat, and carried it home. The family in that small farm homestead consisted of ten persons. The farmer and the whole family died of plague. One could not say in that case whether the man got the infection from the fur coat or from the corpse. There was also a case recorded near Liaoyang. A carter was given a sum of money to take a corpse away from a village. He rolled it up in tobacco leaves, and carried it to a village near Liaoyang. There he became afraid of discovery, left his cart in a yard, and went away with the mules. The innkeeper took possession of the cart and the tobacco, perhaps in payment of his bill. Then he found the body, which was promptly buried, but he retained possession of the tobacco and of the cart. Plague broke out in that inn, and all the inhabitants died.

Dr. STRONG, speaking upon the question of the possibility of dust carrying infection, said that he thought it was a well-known fact, as he had said a few moments before, that as soon as the

plague organism was thoroughly dried it was killed. Therefore dry dust blowing about in the air could not be regarded as a means of carrying infection. It was possible that small, frozen particles of sputum might be blown about and be a means of causing infection, but dry dust was not a means of infection.

Dr. PETRIE said that he thought that the question of the duration of infectivity of rooms or houses was a very important one, but there appeared to be no definite evidence upon this point. It might be that houses lost their infectivity very quickly after the removal of cases. If that were so, one would suppose that the mere closing of houses for a short time would be a sufficient means of disinfection. He presumed that disinfection of houses was done upon the assumption that the houses retained their infectivity for some considerable time.

Dr. STRONG was of the opinion that houses should be disinfected as soon as possible after a case of pneumonic plague had occurred in them. It did not matter so much just how long they remained infective, because if rats or other animals should consume the sputum they might develop plague in that way, and later an epidemic of bubonic plague might occur.

Dr. GRAY asked Dr. Strong whether he thought it possible to disinfect houses built of soft mud walls.

Dr. STRONG replied that he had no experience in disinfecting mud houses, and did not know. He was not speaking about mud houses, but about houses which it was practicable to disinfect.

Dr. FARRAR stated that it should be remembered that in India it had been shown that, however grossly a house might be infected by artificial means, yet, if the house were free from rats or fleas, it was not infective for susceptible animals. A house was not infective apart from rats and fleas.

Dr. STRONG remarked that this, of course, applied to bubonic plague.

Dr. ANDREW said that he might add that the Indian Plague Commission had carried out two series of experiments with grossly contaminated floors. In one set of experiments the floor was quite dry; in the other it was moist. The period of infectivity did not last more than ten hours in the first case, and not more than thirty-six hours in the latter.

Dr. STRONG said that the plague organism lived much longer in sputum, which would become dry much more slowly than the moistened floor. If the sputum were frozen, which was not likely to occur in India, the organism might live for a long time.

Dr. WU said that this question was very important in connection with the measures that might be recommended at later dis-

cussions. If the plague germs in houses spontaneously lost their infective properties, ought houses to be disinfected and ought they to be burned? They should try to get all the evidence they could, so that when the time came they could make definite recommendations.

Dr. FARRAR asked if there had ever been a case of plague occurring after the evacuation of a house and its reoccupation.

Dr. WU said that they had disinfected a lot of houses with carbolic acid, sulphur, and other materials, yet persons afterwards died in them. That showed the difficulty of disinfecting the lower-class Chinese houses.

Dr. STRONG. Were these houses reinfected?

Dr. WU. They were closed and sealed, but men stole in, and died there.

Dr. FARRAR. But they did not get infection in the houses?

Dr. WU. We have no proof.

Dr. CHRISTIE. I think we ought to give some definite advice upon this point. The question has arisen whether we were justified in burning some houses, or whether disinfection would suffice.

Dr. WU said that that was a question which would be dealt with later.

Dr. GRAY expressed the opinion that there was no positive evidence that houses remained infective.

Professor ZABOLOTNY stated that it had been observed in Astrakhan that infection had happened in nondisinfected houses some months after plague cases had occurred in them. The same thing had been observed in Harbin, the infection having taken place after a lapse of three weeks to one month. Dr. Mischencki had found that the sputum retained its infection, even when half dried, for a month.

Dr. BOGUCKI stated that he had observed that even where houses had been disinfected with sublimate or carbolic acid, cases of plague occurred in them about a month afterward. The Conference should give an opinion as to which method of disinfection was best for Chinese houses.

Dr. STRONG desired to know whether there was any definite evidence in these cases that the infection occurred in the houses.

Dr. BOGUCKI replied that his observations were not conclusive, and could not be regarded as excluding other causes of infection.

Dr. FARRAR said that he thought it ought to be clearly stated that no definite evidence to the effect that houses or their contents remained infective had been put before the Conference.

The CHAIRMAN said that what Dr. Farrar had said was very

interesting, but after Dr. Strong's remarks about the sputum remaining infective for several weeks if frozen, or damp, it was rather difficult to say that they had no evidence that houses might remain infective. It was evident that where there was infective sputum, the houses must be infective.

Dr. Farrar said that they would be coming very soon to the last part of the programme. Among the points to be considered, when they came to it, was the question of the effect of the epidemic upon trade. They ought to have evidence in regard to this question laid before them. He suggested that railway and customs officials, as well as the leading merchants and shipping firms, should be invited to supply information upon this point. To be in a position to deal with this phase of the epidemic, information must be sought from those who were able to give it.

Dr. Gray thought that this was a matter which might be left to the programme committee.

On the question of *Evidence as to natural immunity in persons exposed to infection,* Dr. Lewis said that he had come across a case in which a man escaped infection, although he had taken care of four of a family who died of plague, and although he had slept one night on the same *k'ang* [brick bed] as his brother, who also died of plague.

Dr. Strong said that in regard to such cases it was difficult to say whether immunity was due to natural immunity or lack of opportunity of infection by inhalation.

The Chairman said that the case of Dr. Ku, the Chinese physician, might appear to be one of natural immunity. But when he was cross-questioned it was found that he had inoculated himself with a needle used a few hours previously for puncturing plague cases. It was, therefore, a question whether his was a case of natural or acquired immunity.

Dr. Lewis said that Dr. Ku had told him that he always burnt his needle before using it.

Dr. Aspland pointed out that he could not have burnt one of them because there was still blood upon it. [This needle was on exhibition at the Conference.]

The Conference then proceeded to discuss subsection 12, the question of the *Danger of transmission of the infection to rats during the epidemic.*

Dr. Andrew said that in regard to this question the evidence put forward by Dr. Iasienski, Professor Kitasato, and himself, as regards outbreaks of plague in Japan, Manchuria, and Newchwang, pointed to the fact that the rat population was not capable at present of disseminating plague infection. In Japan,

in Newchwang, and in Tongshan the bubonic epidemics started in the autumn, so that at present it seemed that for some reason or other the rat population could not be affected by an extensive epizoötic.

Professor KITASATO stated that in his opinion the time of danger from rats had not yet begun, but that perhaps in the summer they would have to reckon with an epizoötic of plague in rats, and consequently with a human outbreak.

The Conference then adjourned until the following day.

SESSION XII, APRIL 18

PROGRAMME ARRANGED FOR THE DAY

Preliminary discussion on the subject of the tarbagan in its relation to plague.

A. EPIDEMIOLOGY.

13. Statistical data:
    a. The death rate from the disease in different communities.
    b. Age incidence.
    c. Sex incidence.
    d. Race incidence.
    e. The incidence in various classes of the population as judged by their social condition.
    f. Occupational incidence.
    g. Incidence among contacts at different stages of the past epidemic.
    h. Statistics relating to the liability to infection of doctors, students, nurses, attendants, and members of the sanitary staff.
    i. Case mortality in different places.

D. MEASURES EMPLOYED TO COMBAT THE EPIDEMIC.

1. Prophylactic inoculations with vaccines and sera.
    d. Local and constitutional effects produced by vaccines and sera obtained from different sources.
2. Measures to be taken to limit the spread of infection in an infected town or village.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Observations on the flea infestation of the tarbagan.
3. The susceptibility of the tarbagan to plague infection.
4. Some conclusions derived from statistics made at Fuchiatien; discussion.
5. Plague-preventive measures in Japan.
6. Constitutional effects following prophylactic injections.
7. Education of the people by means of public lectures, pamphlets, and bulletins.
8. Disinfection.
9. Notes of the epidemic of plague in Mukden.
10. Measures taken against plague in South Manchuria.
11. A successful antiplague campaign in Mexico.
12. The Changchun epidemic.
13. Preventive measures taken at Fuchiatien.

PRELIMINARY BUSINESS

Dr. Wu took the chair.

The Secretary read the following telegram addressed to Professor Kitasato, Mukden, dated Port Arthur, April 17:

"You will kindly convey my best compliments to the distinguished gentlemen of the International Plague Conference who have honored me with their visit to Port Arthur, and tell them that it is my deep sorrow that unexpected weather had destroyed my programme that might have entertained them better than they were yesterday. (Signed) General Viscount Oshima, governor-general, Port Arthur."

The Chairman. The Governor has not only entertained us exceedingly kindly but he has now expressed his regret that the weather spoiled his programme. I am sure we enjoyed it in spite of the weather. I propose that a suitable reply be drafted, thanking him for his great kindness and hospitality. Also we must not forget the president of the South Manchuria Railway, who did his best to make our trip a great success. I suggest that a telegram also be sent to him to thank him for his kindness.

The minutes of Session XI were passed.

Dr. Aspland. I should like to make an explanation in regard to the non-appearance of the résumé to-day. There is so much back work in revising reports in connection with the editorial committee that we find it simply impossible to issue a résumé.

The Chairman. Before we pass on to the programme of the day, I should like to draw your attention to some very interesting work which has lately been done here by Dr. Strong and Dr. Petrie. It is so interesting that perhaps the Conference would like to hear a short account of it before we proceed with the regular programme of the day.

The first paper read was upon

OBSERVATIONS ON THE FLEA INFESTATION OF THE TARBAGAN

By Dr. G. F. Petrie

I must beg the indulgence of the Conference for departing from the strict order of the programme in the brief remarks I am about to make. My excuse is that quite recently I have made some observations which appear to me to supplement the important papers by Drs. Ch'uan, Gray, and Iasienski. Dr. Iasienski's report seems to be of especial value, since presumably he has had exceptional opportunities for becoming acquainted with available information on the subject. The position summarized from the papers we have heard may be stated as follows:

1. There is evidence that an epizoötic in the tarbagan, having a definite seasonal prevalence in the autumn months, exists in the tarbagan-hunting region of northwestern Manchuria, northern Mongolia, and in trans-Baikalia.

2. This epizoötic has been found to be associated with bubonic and pneumonic outbreaks in man.

3. There is a strong suspicion that the tarbagan disease was responsible for originating cases of pneumonic plague in man at the beginning of the recent outbreak.

4. It must be inferred, although rigid bacteriological proof is wanting, that the disease of the tarbagans is really plague. The important questions then are:

(*a*) How is plague transmitted among the tarbagans.

(*b*) How is plague infection in the tarbagan transmitted to man.

As to the first question, in the light of our knowledge of the transmission of plague among rats by fleas, it seemed necessary to find out whether a similar method of transmission might not take place in the case of the tarbagan. So far as I know, nothing has hitherto been published regarding the insect infestation of these animals. I do not know that any species of flea has been described as infesting the tarbagan, but I should be glad if any of the Delegates will enlighten me on this point. A few days ago I had the opportunity, through the kindness of His Excellency Alfred Sze, of examining for fleas twelve adult tarbagans brought here from Manchouli. The animals were captured wild, apparently having been dug out of their burrows. Each animal after being chloroformed was carefully searched for fleas. I must thank Dr. Andrew for his kind assistance in this somewhat difficult operation. The flea count on each animal was as follows: 2, 2, 2, 3, 0, 2, 2, 5, 2, 0, 12, 3, a total of 35 fleas, giving an average of nearly 3 fleas per animal. It is interesting to note that this number corresponds well with the average number of fleas found on *Mus rattus* in Bombay during the nonplague and flea season. The flea found on the tarbagans is a large flea, reminding one so far as size is concerned of the unusually large flea which infests the mole. I hope to have the flea identified by Mr. Rothschild, who is an authority on the subject. Only one of the fleas survived the chloroform. This specimen obtained on the evening of the 13th is still active. On the 14th an attempt was made, but without success, to get it to bite the arms of six persons. On the evening of the 16th, the flea having starved for three days, Dr. Andrew tried the experiment again, and found that it undoubtedly bit him, the bite giving rise to a small reddish areola which was visible next day as a bluish spot. On the 17th the flea was found again to bite when placed on the arm. When examined with a hand lens during the act, the proboscis was seen to be embedded in the skin, the flea having also the characteristic tilted attitude of

these insects when biting. The churning movements of the stomach usually seen preparatory to biting were observed, but the stomach of the flea did not appear to fill with blood. These observations suggest and indeed make it almost certain that during the season for plague in the tarbagan, these animals are infested with fleas. It remains to be proved that the tarbagan is the proper host of the species of flea taken from them. That, however, is a matter of academic rather than of practical importance. The observation that tarbagans are infected with fleas seems to me to be of great significance in connection with the spread of plague among these animals. That the fleas are able to bite man also helps in explaining the mode of transmission of the infection from the tarbagan to man in bubonic cases. As to the relationship of the tarbagan to pneumonic plague in man, several possibilities suggest themselves, the value of each of which it is impossible at present to estimate. One of these may be noted, viz., that a bubonic or septicæmic case in man, originating from a plague tarbagan, may, if a secondary pneumonia supervenes, give rise to a case of primary pneumonic plague. It is with regard to this possibility that these observations have a special bearing on the origin of the past epidemic.[1]

The next subject considered was

THE SUSCEPTIBILITY OF THE TARBAGAN TO PLAGUE INFECTION

By Dr. R. P. STRONG

The experiments about which I have been asked to speak are not yet completed. They were performed by Dr. Teague and myself. On April 14 we inoculated six large tarbagans (*Arc-*

[1] SUPPLEMENTARY NOTE.—I had no literature in Mukden to aid me in identifying these fleas. Dr. C. J. Martin, F. R. S., and the Hon. Charles Rothschild have identified them with *Ceratophyllus silantievi* Wagner (Wagner, 1898). This flea was captured in Russia, on the tarbagan (*Arctomys bobac* Schreb.), by Silantiev, and is described in an article by Tiraboschi (Les rats, les souris, et leurs parasites cutanés dans leurs rapports avec la propagation de la peste bubonique (*Archives de Parasitologie* (1903–4), 8, 161). Tiraboschi fully recognizes the importance, from the standpoint of plague, of the observation that tarbagans are infested with fleas. In an interesting paper by Dr. Doudchenko-Kolbasenko, kindly translated for me by Mr. Brauns (*Journal of Hygiene, Legal and Practical Medicine*, published by the Chief Medical Inspector, Ministry of Interior, July 1909, St. Petersburg), it is noted that: "In the fur of the tarbagan there are always numerous fleas with a long body and reddish-brown color. These fleas do not live on man, but if they get on man they bite him. After the bites, red spots appear and sometimes swellings resembling urticaria." My attention was drawn to this paper, after I had made my observations, by Dr. Paul Haffkine and Professor Zabolotny, and to these gentlemen I am glad to express my obligations.

tomys bobac Schreb.) obtained through the kindness of H. E. Alfred Sze. Three of the six were inoculated cutaneously by scarification of a small area of the shaved abdomen, and then by rubbing in five œsen of a suspension of one forty-eight-hour pneumonic-plague agar culture suspended in 5 cubic centimeters of peptone solution. The remaining three of the six tarbagans were inoculated by dipping a needle of a 5 cubic centimeter syringe into this same suspension and thrusting it beneath the skin of the animal. The results of this series are as follows:

No. 1 was found dead on Sunday morning, the 16th, less than forty-eight hours after inoculation. Dr. Teague performed the necropsy. He found that the animal had died from plague. The inguinal glands on both sides were materially involved; a bubo with hæmorrhages was found in the right axillary region. Cultures from the spleen, heart, and bubo all showed a good growth of plague bacilli.

No. 2. was found dead yesterday morning, the 17th, that is nearly two and one-half days after inoculation. At the necropsy there was a marked hæmorrhagic reaction in the region of the point of inoculation and an inguinal bubo on the left side; on the right side, the inguinal and axillary glands were not swollen. The spleen was much enlarged. Smears made from the bubo and spleen showed innumerable plague bacilli; cultures were made from the heart, but I have not had time to examine them this morning.

No. 3, which was inoculated cutaneously, died on the 17th in the afternoon, about three days after inoculation. There were hæmorrhages about the point of inoculation; on the left side there was an inguinal bubo. The glands on the right side were not swollen; the axillary glands were normal. There were numerous hæmorrhages in the omentum and bladder and in the intestinal wall, particularly of the duodenum; the large intestine contained a considerable amount of thin, bloody, mucus material. The liver was congested, mottled, yellowish-red, and the spleen was greatly enlarged. In the lungs were a few pinhead-sized petechiæ; otherwise the lungs were normal. In smears made from the spleen and bubo, innumerable plague bacilli were found.

No. 4. died at 5.30 p. m., about fifty hours after inoculation, and the necropsy was made by Dr. Teague. Half of the shaved area of the skin was elevated and inflamed. The inguinal glands on the left side were materially enlarged. There were axillary buboes on the left side. The spleen was enlarged and rich in

blood. Numerous plague bacilli were found in smears made from these glands and from the spleen. Cultures of the heart's blood and spleen were also positive for plague bacilli.

The result of this experiment, so far, is that four of the six large tarbagans are dead of plague infection. The first died in less than forty-eight hours, the second in fifty hours, the third in two and one-half days, and the fourth three days after inoculation. At the same time we inoculated six white mice. All of these have since died of plague infection. They were inoculated by "sticking," in the same way as three of the large tarbagans. Some of the tarbagans died in about the same time after infection as the mice, although they received the same dose. One guinea pig for comparative purposes was inoculated cutaneously in the same way as three of the tarbagans; this guinea pig and the two tarbagans are the only animals of the experiment still alive.[1] Six of the small marmots (*Spermophilus citillus* Linn.), which are commonly found here in Mukden, were inoculated in the same way. Only one has so far died of plague. It died yesterday afternoon. So these animals are apparently somewhat less susceptible to plague infection than the tarbagan.[2] We hope to be able in a few days to report upon the results of pneumonic infection in tarbagans and to give a complete report of the present experiments. These experiments merely demonstrate that the tarbagan may be very susceptible to plague infection, which I think has not been shown before.

I apologize for not having my notes in better form to present to you, but I did not know that they would be wanted this morning.

The CHAIRMAN. We will now proceed with the programme.

Dr. FARRAR. May I first ask that it be understood that this question is not complete and has not been fully discussed, and that it will be discussed at a later time when Dr. Strong's findings are complete and we have other data.

The CHAIRMAN said that he was quite sure that the Delegates would like to have this discussion thoroughly gone into at a later time.

Professor ZABOLOTNY said that he wanted to ask some questions, and then further experiments could be made. If that were not done now, time for the experiments would be lost.

[1] The guinea pig died of plague infection on the sixth day after inoculation. For the further notes on the tarbagan in relation to pneumonic, subacute, and chronic plague infection, see Session XXIII, page 385.

[2] Of the small marmots, one died three days after infection, one four, two five, one six, and one seven days after infection.

The CHAIRMAN said that if it was the wish of the Conference that they should devote the next few minutes—say, not more than ten or fifteen minutes—to this discussion, they would all be glad to hear other expressions of opinion.

Professor ZABOLOTNY first asked if he had understood Dr. Petrie to say that the tarbagan flea bit man. He then went on to say that it was quite possible that dirty hands brought to the mouth after handling an infected tarbagan might produce the pneumonic form of plague, in such cases, for instance, as when the tarbagan hunters were handling the animals' skins. He expressed the desire that more tarbagans should be procured, as he would like to see more experiments made *ex concilio* of all the Delegates. It was quite possible that the tarbagan could be infected *per os,* if it ate meat. In this way it might be infected from plague corpses. That seemed to him the natural method of infection. He concluded by again recommending experiments *ex concilio* with more tarbagans.

Professor KITASATO suggested that it would be better for investigators of China and Russia to study this question later on. Just now it was not the time to make these experiments. It would be preferable to wait. The Chinese and Russian doctors would have a good chance of studying the question here because they were located in the infected country.

Dr. PETRIE stated that he quite agreed with Professor Zabolotny's idea that there were various methods by which the tarbagan could be infected. No doubt the possibilities of infection mentioned by him were right, but he did not think the question could be settled without rather an extensive examination of the natural diseases of the tarbagan. In that connection he thought that Professor Kitasato was perfectly right. Only study upon the spot could clear up all these possibilities. The important question was not what were the possible methods of infection among tarbagans and from tarbagans to man, but what was the really common mode of infection. No doubt the tarbagan could get infected by eating a plague corpse—a human corpse he understood was meant. Still one could hardly regard that as an ordinary method of infection. He believed himself that there was some ordinary method of infection among tarbagans, and these observations with fleas seemed to him to be suggestive only. He thought undoubtedly that in order to clear the whole thing up an examination on the spot should be made.

Dr. BROQUET thought that, if necessary, before the Conference closed all the animals so kindly procured by H. E. Alfred Sze should be utilized. He recommended that all the competent

bacteriologists staying here should try to make as many experiments as they could while the Conference was going on, so as to prevent duplicate experiments being made later.

Dr. FARRAR asked Professor Zabolotny whether it had been confirmed that the tarbagan did eat human flesh.

Professor ZABOLOTNY said that it had been confirmed because human bones had been found in their holes. This had been shown by the expedition of Dr. Podapielsky.

Dr. STRONG said that he quite agreed with the gentlemen who had spoken in regard to the point raised that the tarbagan question should be most carefully and extensively studied. He hoped the Conference would pass a resolution to that effect. The few experiments he had so far reported only showed that the tarbagan *might* be very highly susceptible to plague infection.

Dr. PETRIE. They are extremely important.

The CHAIRMAN asked whether the meeting wished that Dr. Strong's proposal should be discussed now or later on.

Dr. STRONG. I suggest later on.

The day's programme was then proceeded with.

The next paper was upon the subject of

SOME CONCLUSIONS DERIVED FROM STATISTICS MADE AT FUCHIATIEN

By Dr. CH'UAN

1. *Mortality.*—The mortality has been greatest among the coolie and poorer classes. In Shuangchengfu, however, nearly half the deaths occurred among people of the better class and among families.

2. *Age.*—The age of greatest susceptibility to the disease is between 20 and 40 years, 60 per cent of the total deaths occurring in patients during this period. The age of least susceptibility is between 1 and 10, and above 60.

3. *Sex.*—Both sexes are equally liable to infection; although in Fuchiatien few women were attacked, in Shuangchengfu about one-third of the deaths were among females.

4. *Race.*—Although few Europeans were attacked, this apparent immunity might be due to a more hygienic mode of living and to better sanitary surroundings. Once the disease develops, the same want of resistance is noticed, as, for example, in the cases of Dr. Mesny and Dr. Jackson.

5. *Social conditions.*—The lower and poorer classes seem predisposed to the disease, but the higher classes of people also, if exposed, succumb to it.

6. *Occupation.*—The poorer laborers seemed the more liable to be attacked, although no class appeared immune.

7. *Contacts.*—Four thousand one hundred and eighty-seven plague contacts were received in the camp. Two hundred and eighty-five were sent to the hospital and died, a percentage of 6.7; deducting the mortality during the period before the quarantine station was in working order, it was 5.5 per cent.

8. *Medical and sanitary staff.*—The greatest mortality appeared among coolies and ambulance carriers, and also among native practitioners. In a native hospital in Changchun, one senior practitioner, two assistants, and five attendants died within one week after the opening of the hospital. The case mortality totaled 43,300.

DISCUSSION

Dr. PETRIE said that it occurred to him that Dr. Ch'uan's figures scarcely represented the real incidence upon the members of various groups, because the number in each group exposed to infection naturally was not known. He did not suppose that the figures were given with that idea. He supposed that epidemiologists would tell them that these figures did not represent the real incidence of the disease among the various groups. For instance, native practitioners might work out at 90 per cent instead of 44 per cent if one knew the number that was exposed to infection.

Dr. CH'UAN said that the following statistics were only of people connected with the antiplague work at Fuchiatien.

List of deaths of antiplague staff at Fuchiatien

Class.	Number.	Per cent.
Doctors	1 out of 20	5.0
Students	1 out of 29	3.5
Native practitioners	4 out of 9	44.0
Police inspectors	2 out of 31	6.0
Police	30 out of 688	4.3
Sanitary police	11 out of 206	5.3
Mounted police	5 out of 80	6.2
Firemen	5 out of 20	25.0
Coolies	102 out of 550	18.2
Cooks	4 out of 60	6.6
Ambulance parties	69 out of 150	46.0
Soldiers	63 out of 1,100	5.7
Total	297 out of 2,943	

Dr. FARRAR said that these figures must be taken for what they were worth. The figures might be accurate but not of statistical value, because obviously people exposed were nearly all coolies between the ages of 20 and 40. They were, therefore, of no value for giving the age incidence.

Dr. KASAI stated that he had tables of statistics of the occurrence of the disease in each class of the people, of their age, nationality, and their occupation during this epidemic, but he thought that the statistics of this epidemic did not permit one to draw general conclusions because plague had occurred chiefly in the coolie class. (Dr. Kasai's tables are as follows.)

TABLE I.—*Nationality and sex of cases of pneumonic plague occurring in South Manchuria*

Nationality.	Males.	Females.	Total.
Japanese	1	1	2
Coreans	15	4	19
English	1		1
Chinese	5,379	463	5,842
Total	5,396	468	5,864

TABLE II.—*The ages of a portion of the cases of pneumonic plague occurring in South Manchuria*

Age (years).	Number.	Per cent.	Age (years).	Number.	Per cent.
Under 10	82	2.48	50 to 60	331	10.04
10 to 20	211	6.40	60 to 70	133	4.03
20 to 30	902	27.36	70 to 80	39	1.03
30 to 40	1,006	30.52	Over 80	3	0.09
40 to 50	589	17.87	Total	3,296	

TABLE III.—*Comparative number of pneumonic-plague cases of both sexes and their ages in South Manchuria*

Date.	Adult males between 15 and 60 years of age.		Other cases.		Total. number.
	Number.	Per cent.	Number.	Per cent.	
January 1 to 10	32	94.12	2	5.88	34
January 11 to 20	236	95.93	10	4.07	246
January 21 to 31	471	91.46	44	8.54	515
February 1 to 10	510	89.32	61	10.68	571
February 11 to 20	611	84.63	111	15.37	722
February 21 to 28	346	76.04	109	23.96	455
March 1 to 10	227	82.25	49	17.75	276
March 11 to 20	52	80.00	13	20.00	65
March 21 to 31	11	91.67	1	8.33	12
Total	2,496		400		2,896

If we subtract the number of adult males (2,496) from the total number of cases (2,896), there remain 400 cases which occurred among the very old and young males and the females. From the above table it is seen that infection within families occurred particularly in the period from February 11 to 20 (111 cases) and from February 21 to 28 (109 cases).

TABLE IV.—*The occupations of the pneumonic-plague patients in South Manchuria*

Occupation.	Number.	Per cent.
Coolies	1,684	36.66
Farmers	882	19.03
Artisans	355	7.74
Members of the plague sanitary corps	122	2.66
Merchants	706	15.38
Vagrants	553	12.06
Undetermined	180	3.92
Total	4,482	

Among the 122 cases occurring among the members of the plague sanitary corps there were 1 Japanese, 1 English, and 40 Chinese physicians.

TABLE V.—*Localities in South Manchuria where the sick and dead bodies were found*

Locality.	Number.	Per cent.
In observation barracks	542	22.34
In inns	93	3.83
In coolie houses	35	1.44
In houses	1,100	45.34
In railway coaches	3	0.12
At railway stations	8	0.32
In deserted houses	65	2.67
On the streets	518	21.35
In open fields	43	1.77
At other places	19	0.78
Total	2,426	

The CHAIRMAN said that if there was no more discussion on this section of the programme they would pass to the next subject, Section D, *Measures employed to combat the epidemic*.

The first paper was on the subject of

PLAGUE-PREVENTIVE MEASURES IN JAPAN

By Professor KITASATO

The Japanese Government took preventive measures in 1879 against the introduction of dangerous infectious diseases, and imposed quarantine restrictions. If an infectious disease is reported on a ship, the case is immediately isolated in the hospital of the quarantine station, the ship being thoroughly disinfected. In case of plague the ship is filled with carbon monoxide to destroy the rats, as is done at Hamburg.

If plague breaks out, the following measures are also adopted in Japan:

The infected persons are compulsorily removed to the plague isolation hospital and the bodies of those who have died are cremated. The family of the patient and all those in contact with him are sent to an observation station for contacts, and are kept for ten days under medical observation. The infected house and all the buildings which are connected with it are closed and surrounded with corrugated iron. The openings of the house drains are closed with a wire netting to stop the exit of rats. Afterwards poisoned baits are laid in the house for the rats and left for at least forty-eight hours; traps are set, and in summer insect powder is scattered. Afterwards the house and its furniture are disinfected and, if necessary, parts of the house are pulled down to search for rats; especially in winter the floor of the house is also taken up to expose rats' nests. The destruction of rats is carried out completely, and the house is kept isolated for ten days, no one being allowed to enter it.

To find plague patients quickly, the inhabitants of the infected or suspected neighborhood are kept under observation by medical and police officers. If necessary, they are sent to the observation station. All the rats which have been found dead or have been caught are required to be delivered to the police officer, and a reward of 5 to 10 sen [2½ to 5 cents, United States currency] for each rat is given. In the police office bacteriologists are available to examine the rats. If a plague-infected rat is found, the house from which the rat comes is disinfected, but this disinfection of houses was often not practicable, since inhabitants throw away dead rats to avoid the inconvenience of disinfection. From 1898 to 1907, twenty millions of rats have been caught in Tokyo, Yokohama, Osaka, and Kobe. The destruction of rats and their bacteriological examination is not only done in infected places but also in the neighborhood of such places. These measures were successful in combating the plague.

During eleven years, notwithstanding the introduction of plague thirty-six times, only 1,112 persons contracted plague, of whom 894 (i. e., 80.5 per cent) died.

Contacts are passively immunized with plague serum. The other inhabitants of the infected neighborhood are actively immunized with plague vaccine if they wish it. These two methods of immunization were found very useful a few years ago in Formosa, and are now employed during every outbreak of plague in Japan. In 1905 at Yuasa in Wakayama-ken, a place of 7,700

inhabitants, plague broke out for the second time, and 132 people rapidly contracted the disease. Ninety-one, or 1.71 per cent of the inhabitants, died. Notwithstanding the severest measures, it was impossible to stop the plague. Preventive inoculation was then tried. It was at first very difficult to inoculate all the inhabitants; but afterward, when the people found out that the inoculated persons remained free from plague whereas the non-inoculated were stricken, they submitted to inoculation, with the exception of a few in poor health. Then it was found that human beings no longer contracted the plague, though the disease was still prevalent among rats.

Two persons contracted the disease from three to five days after the first inoculation, but recovered quickly, whereas those who were inoculated twice remained free.

For the preparation of our vaccine we use a fresh agar culture of highly virulent plague bacilli according to Pfeiffer and Kolle's method. The culture is kept for forty-eight hours in the incubator at 32° C., when the growth is scraped off. It is heated half an hour at 60° C. to kill the bacilli and is afterward diluted with a carbolic saline solution (carbolic acid 0.5 and sodium chloride 0.8 per cent). One cubic centimeter contains 6 milligrams of dead bacilli. Before use, a control test is made with animals. The inoculation is performed twice for adults; at first, 1 cubic centimeter is given and, after seven to ten days, 2 cubic centimeters. For controlling plague, this inoculation is an efficient and inexpensive measure. I consider it necessary to practice this preventive inoculation in places where general measures fail to give satisfactory results. In Japan, plague is not endemic, but has always been imported from foreign parts. Thanks to the progress of science, we have been able so far to master this dreadful enemy, notwithstanding our extensive coast line.

I consider the prospect of successfully combating plague favorable if the following measures are energetically carried out:

1. Plague cases must be discovered and isolated as soon as possible.

2. The families of the plague patients and all contacts must be isolated for a certain time to see if infection has already taken place. It is also necessary to immunize contacts passively at an early stage with plague serum. Hundreds of contacts died from plague pneumonia in the contact stations during the past epidemic.

3. The houses of plague patients, together with the furniture, must be thoroughly disinfected.

4. If necessary, active immunization with dead agar cultures of plague bacilli should be carried out.

5. Not only cases of plague but also all the suspected cases should be officially reported. An obligatory medical inspection of corpses is necessary.

6. To discover plague patients as soon as possible, the inhabitants of the infected and suspected places should be under the observation of official doctors and police officers. With persons suspected of disease, protective measures should be taken.

7. Plague corpses should be cremated.

8. The destruction of rats must be carried out by poison, traps, cats, etc. All the rats which have been found dead, or caught, must be delivered to the police officers, and a reward given. It is absolutely necessary to have a bacteriological examination made of all the rats given to the police officers.

The small marmot or ground squirrel [*Spermophilus citillus*], much smaller than the tarbagan, which is found in large numbers near Mukden and all over Manchuria, is susceptible to plague after an artificial inoculation. A millionth of a loopful of agar culture of plague bacilli injected subcutaneously killed one in from six to seven days. The autopsy showed almost the same lesions as are found in rats. Plague is not known to occur naturally among these animals, but this question requires careful study.

Then followed notes on

CONSTITUTIONAL EFFECTS FOLLOWING PROPHYLACTIC INJECTIONS

By Dr. Woo Wai U

1. *Prophylactic vaccines.*—The vaccines used were: Bombay vaccine one and one-half years old; Russian vaccine made with a pneumonic strain; Shanghai vaccine varying from six weeks to two years old; and Andrew's polyvalent vaccine manufactured locally.

The effects after inoculation were as follows: An initial rigor six to twelve hours after injection, headache, sometimes vomiting, pain in the bones, local swelling, considerable pain, and fever from 101° to 103° F. The constitutional effects varied in different persons. A bubo was seldom noticed.

2. Serum was used either alone or with vaccine. The constitutional disturbances were not so marked as with vaccine alone. The serum used was of French, Russian, or Japanese manufacture.

The effects after injection were usually not so severe as with the vaccines, but urticaria sometimes followed the injection

which remained well marked after five days. This seemed to vary with the different varieties of serum. Out of seven cases treated with Paris serum, five developed general urticaria, including Dr. Wu's case mentioned separately, whereas none of the twenty-eight men, on whom Russian serum in hermetically sealed capsules was used, showed any bad effects.

Following are the notes of a case of abnormal constitutional effects following the injection of serum:

January 11, 10 cubic centimeters of Paris antipest serum were injected beneath the skin of the left abdomen. The bottle from which the serum was taken had a badly fitting rubber cork. January 12, the patient had fever 101°.5 F.; pulse 92; headache, and slight pain over back. January 13, there was pain in the bones. January 14 and 15, vomiting, sleeplessness, and general weakness. January 16, patient still very weak, pains in bones severe. At 9 p. m. severe urticaria set in while out dining; increased at midnight; restless for twelve hours, no sleep. January 17, no fever, no sleep. January 18, pain all over body worse; some petechiæ over both axillæ, shoulders, and abdomen; joints and bones stiff, glands in neck, axilla, and groins enlarged and tender, pain in shoulders most severe. Patient unable to abduct arm or put on clothes. Temperature normal, pulse normal; potassium iodide and sodium salicylate tried, but no relief obtained; urticaria better toward evening. January 19, patient slept fairly well; pain over shoulders still present; pain in glands better. January 20, pain in bones better; urticaria gone. January 21, pain in bones and joints much improved. February 20, no recurrence of pain, except pain in shoulders, which has come on almost once a week. March 20, still occasional pain in shoulders, especially in the left where slight stiffness remains.

The following notes were then read:

THE EDUCATION OF THE PEOPLE BY MEANS OF PUBLIC LECTURES, THE ISSUE OF PAMPHLETS, AND POPULAR BULLETINS

By Dr. Stanley

I have found the distribution and posting of handbills, giving in simple language the main measures for preventing disease, of great use in Shanghai as a means of sanitary education of the people. The distribution is done by men provided with bells, who attract a crowd to whom they give the notices after reciting the contents for the benefit of those who can not read. Lectures are also given in the district health stations by educated men of the teacher class, to whom the common people listen with rapt attention.

Forcible sanitation is advisable for meeting such a sanitary crisis as occurred during the past epidemic, but for permanent sanitary amelioration the measures taken should have the willing consent of the people. The education of the people, therefore, may be considered the necessary preliminary to real sanitary progress.

NOTES ON DISINFECTION

By Dr. STANLEY

Regarding disinfection after a case of pneumonic plague, the question is, What is there to disinfect?

It appears to be pretty clear that infection during the past epidemic has been chiefly, if not exclusively, from the infected breath of patients, especially during coughing. Inanimate objects, such as clothing, corpses, and merchandise, do not appear to have been an important factor in spreading infection. After removal of the patient to an isolation hospital, little, therefore, remains to be disinfected, as the bacillus has low powers of resistance outside the body. The bacillus may, however, be found alive in undried sputum, and anything soiled with such sputum is potentially infective for man and rodents, and should, therefore, be disinfected. The possibility of infected rats and fleas may also be considered.

In the stress of the epidemic, without the means of steam disinfection, burning of clothing, etc., was justified, as was also the burning and destruction of houses when actually dilapidated.

The carefully sealed-up northern house would appear to lend itself to sulphur fumigation, and this method can be recommended, especially for its use in killing rats and fleas; but it is more suitable for dealing with bubonic than pneumonic plague, sulphur fumigation being a method of disinfestation rather than of disinfection.

For the actual disinfection of things soiled with infected sputum, it would be difficult to excel exposure to sun and air, so as to secure rapid drying.

The spraying of roads, rickshaws, etc., by disinfectants appears unnecessary.

From an administrative point of view it is desirable when purchasing proprietary disinfectants that they should be tested and certified in terms of their efficiency compared with carbolic acid as a standard by the Rideal Walker or some similar reliable method.

The next subject considered was

NOTES ON THE EPIDEMIC OF PLAGUE IN MUKDEN

By Dr. Y. S. WANG

1. *Origin.*—The first known case of plague in Mukden occurred on January 2, 1911. The patient came from Harbin by rail, and was found lying ill in the street. He died the next day in the Government Hospital. Within ten days 15 cases occurred. Most of these came by train from the north and died either by

the wayside or in small inns and tea shops between the railway station and the city. The remainder were contacts with these cases, inn employees, or persons in the neighboring hotels. Coolies from the north continued to be poured in by the railway, without quarantine or any restriction, and plague cases steadily increased, especially in the western district.

2. *Antiplague organization.*—The organization of a campaign against plague began with all possible speed. A large number of my hospital staff were in Harbin, fighting the plague there; no sanitary staff was in existence, nor any isolation hospital or other available building. By the 12th of January a plan was thought out.

a. *The city was divided* into seven districts, six of which were subdivided into two and the seventh into four districts. In each district an office was opened and a staff organized, consisting of two medical graduates or students, twelve police for searching houses, ten disinfecting coolies, and some bearers.

b. *A disinfecting station* was opened to the west of the city, where all the visiting staff went through a thorough disinfection after each day's work.

c. *House-to-house* visitation began on the 12th of January. It was intended to visit each house in the city daily, but this was impossible owing to the smallness of the staff. For the same reason the inspection could not be very complete. The healthy portions of the city were visited about every second day, and infected portions, as far as possible, daily. Inns, lodging houses, and tea shops were more strictly examined.

d. *Plague cases* were immediately removed and all persons who had been in contact with them. Bedding and clothing were burned, the house disinfected and shut up, or in some cases burned.

e. *The dead* were promptly placed in coffins with lime and disinfectants and buried seven feet deep in a specially prepared cemetery.

f. *As plague hospital,* a small house in the western part of the city was used temporarily, then the Shan-hsi Temple in the seventh district was acquired and prepared for use, but the rooms were small and badly lighted. Plans were drawn for a suitable plague hospital, and buildings of a temporary nature were quickly run up, the severe frost rendering permanent building impossible. This hospital is now completed.

g. *Six isolation stations for contacts* were gradually established, each being well equipped with disinfecting apparatus and under the charge of a medical graduate or student. Later on,

when it became possible to appoint a foreign doctor to supervise all these stations, it was found that the work was being properly done. The results have been most satisfactory.

h. *A bacteriological laboratory* was established near the central plague office, where two Japanese doctors did useful work in bacteriological diagnosis.

i. *Rats* were systematically trapped, about 30,000 in all having been caught since the beginning of February. None have been found infected with plague.

j. *Traffic* between different parts of the city was controlled, carts, rickshaws, and tramways being systematically inspected and disinfected. The city gates were guarded, and anyone who seemed to be ill was prevented from passing through.

k. *For the instruction of the people* several methods were adopted. Idle rumors regarding the nature and cause of plague were floating about, many believing that the wells were poisoned. Indeed, packets were brought to us, found in or about wells, containing powder carefully rolled up and put in a colored cotton bag. This we found to be principally naphthalene. Another rumor, believed by many, was that in the north the patients were frequently buried alive. In order to remove such ignorance and prejudice, intelligent citizens were appointed to give lectures in various parts of the city, although public gatherings of all kinds, such as fairs and theaters, had been stopped and schools were closed. Placards were also posted up, explaining in simple language the nature of the disease and the measures in operation to prevent its spread, and urging all to help the authorities by notifying illness. By invitation, several lectures were given by members of the plague staff, with microscopic demonstrations.

3. *The spread of the disease.*—The measures taken in Mukden would have been enough to stamp out plague very speedily and to prevent its spread to the south and west had not new cases continued to arrive from the north. About 1,000 coolies were brought daily by rail from the infected districts, many going south by the Chinese Railway, many others remaining in Mukden and in the district. At an early stage it was earnestly requested that railway traffic from Changchun should be stopped, but this was not done until a large part of Mukden was infected, nor indeed until after the Chinese Railway from Mukden to Shanhaikuan was closed. When the deaths in Mukden still numbered only four or five daily, it was decided to close the Imperial Chinese Railway, and on January 14 the last train load of coolies left Mukden for Shanhaikuan. Two deaths occurred

on the train, and all the coolies, numbering 478, were returned to Mukden on January 15. Dr. Jackson, of the Mukden Medical College, had that day taken charge of the railway area. No isolation station was as yet ready to accommodate so large a number, so they were housed in inns in the neighborhood of the station, with guards to prevent their leaving. These inns were quite unsuitable for the purpose, being low-roofed, dark, and dirty; but no other place was available. From January 15 there was a marked increase in the Mukden mortality. Many of the coolies died daily, one small inn being used as a plague hospital. Gradually most of the inns became infected, proper isolation being impossible. On the night of January 23, eight days after the return of the train load of coolies to Mukden, over a hundred of the coolies broke out and escaped from their inns. They could not be traced, but there was a sharp rise in the total number of deaths reported a week later in Mukden. Of the remaining coolies, 59 were discharged and the rest were removed to proper contact stations on January 24. On the same day Dr. Jackson was taken ill with pneumonic plague, and died on the following day.

From the beginning there were, especially among the merchants of the city, strong objections to submitting to the official inspection of houses and to the removal of all contacts in the event of a case of plague. Some of the merchants believed that they could improve on the official methods and raised money and started an isolation hospital of their own. Plague cases were placed here under Chinese doctors of the old school. No antiseptics were used. Within a fortnight there were 160 deaths, 4 being among the doctors. The authorities brought strong pressure to bear, and the place was closed on February 20. This venture explains the high death rate in Mukden from February 16 to 21, the number then ranging from 57 to 66 per day, whereas at no other time were the deaths much over 40.

4. *Distribution of the disease.*—At the beginning of the epidemic most of the deaths took place in the seventh division—that is, the region between the city and the railway which contained a large number of inns and roughly built hovels. The total number of deaths in this division was 537, or 30 per 1,000 of the population. The adjoining division, the fifth, came next, both in time and in intensity, with 514 deaths, being 13 per 1,000. Most of the coolie class in Mukden live in this district, or around the labor market in the fourth division, which follows with 211 deaths, or 8 per 1,000. In the rest of Mukden the mortality was much lower, so that the remaining four divisions together only

lost 2 per 1,000 of their population. The majority of the Mukden patients belonged to the day-laborer class, many of whom live under most unfavorable conditions in the poorest parts of the city, chiefly in overcrowded lodging houses.

5. *The decline of the disease.*—When coolies ceased to arrive from the north by rail and the merchants' hospital was closed, the measures taken against plague began to succeed and the mortality diminished rapidly. In the last week of February the daily average was reduced to 33. The four weeks of March gave daily averages of 26, 14, 7, and 2. It is difficult to tell to what degree the steady fall in the death rate was influenced by the preventive measures adopted.

The next paper consisted of a

SUMMARY OF MEASURES TAKEN AGAINST PLAGUE IN SOUTH MANCHURIA

By Professor KASAI

1. *Introduction.*—In October, 1910, it became known that pneumonic plague had broken out in Manchuria and was spreading toward the south. This prompted me to construct isolation hospitals and quarantine stations in the vicinity of the chief stations of the South Manchuria Railway, in order to be prepared for the reception of plague patients and those who had been in contact with them. On November 25 we commenced examining passengers on the South Manchuria Railway and isolating at the stations. These were the first precautionary measures taken. However, it was soon evident that all requirements were not met, for Chinese infected by plague were already found within the railway zone. We therefore issued regulations with the object of preventing Chinese of the lower classes (coolies, etc.) from traveling on the South Manchuria Railway, unless they had previously submitted for a time (seven days) to a close inspection in our quarantine stations and had been proved free of infection.

In order to provide shelter for these Chinese who intended to use the railway, we had to erect, at most stations of the line, large quarantine barracks capable of accommodating from 500 to 5,000 persons. The transportation of coolies by rail was stopped until completion of the barracks and the expiration of the observation term of the first lot of coolies quartered therein.

Many of the coolies, not seeing the necessity for these regulations, evaded the observation term by taking the road and walking to the south, and thus arose a fresh danger of the spread of the epidemic within the railway district. Hence it

was necessary to take measures for watching the railway line by employing police and soldiers for cordon purposes extending from the frontier of the Kwantung territory down to Port Arthur. By these means we desired chiefly to prevent the importation of the epidemic into the important cities of Dairen and Port Arthur. A cordon was drawn across the Kwantung territory from the east to the west coast. The first one formed the natural boundary between the Kwantung territory and Manchuria proper, the second traversed Pulantien, the third the Nanshan Mountains at Kinchow, and the fourth and last cordon crossed the *hinterland* of Port Arthur. These measures may be described as the second line of defense against plague.

We considered that, after having protected ourselves as described, the epidemic would be stamped out entirely within a short time. All the protective measures enumerated so far were enforced simultaneously for several months.

I should like to enter now into greater detail.

2. *Organization.*—The authorities chiefly concerned in the campaign against the plague, viz., the civil administration of the Kwantung territory (Kwantung Government) and the administration board of the South Manchuria Railway, decided upon joint action, and on January 15, 1911, a special temporary sanitary board was established at Dairen to carry out the regulations issued. The boards of administrators and staffs of officials necessary to do this were provided for by the civil administration of the Kwantung territory and the South Manchuria Railway. On January 21 the headquarters of the newly created department were opened at Mukden. The administration of police of the Kwantung territory organized branch offices. These head and branch offices performed their functions, not merely in the Kwantung territory but also within the Japanese consular districts of Manchuria. We further decided, in order to exterminate the epidemic in South Manchuria, to coöperate with the Chinese Government, after having arrived at a proper understanding with them, about the steps to be taken, and, consequently, held weekly Japanese-Chinese conferences for the discussion of all points in question. These meetings have been continued until the present time.

3. *Administration of quarantine stations and hospitals.*—In December, 1910, we built within the Kwantung Government's jurisdiction, in the vicinity of several railway stations, quarantine stations or we altered suitable buildings already existing in order to be able to quarter all persons suspected of plague. But the number of plague patients and suspects increased much faster than we had expected, and as, moreover, we had to quarantine

for seven days, all coolies, etc., who wished to travel by railway, we were compelled to take steps for building extensive establishments.

4. *Extermination and examination of rats.*—At the chief places in the Kwantung Peninsula and Manchuria we distributed rat traps among the house owners and tenants and encouraged the delivery of dead or live animals by giving a reward for each rat caught. In addition, we started lotteries at Dairen and Port Arthur, the highest prize of which amounted to Y100 ($50 United States currency) and the lowest Y2 ($1 United States currency). The lottery tickets were issued free, together with the money we paid for rats delivered to us. All of the rats caught were subjected to close bacteriological examination, but none were found infected with plague.

5. *Medical inspection of coolies and other Chinese of the lower classes.*—Those persons striken by pneumonic plague in Manchuria almost exclusively belonged to the coolie class or to the lowest orders. Consequently, we issued within the Kwantung Government territory, as well as in the railway zone and in our consular districts, the order that such Chinese were to be isolated and medically examined daily. Lodging houses, inns, and so-called coolie houses, situated close to the working places of the coolies, where they take their meals or obtain shelter for the night, were very carefully inspected once or twice a day in order to bring any fresh cases under immediate treatment and to take in hand the isolation of those in contact with such cases.

6. *Measures on steamers and trains.*—As mentioned already, the coolies were required to submit to surveillance for seven days, and only to those whose state of health admitted absolutely of no doubt, permission was given to proceed on foot, by train, or by steamer. The trains carried physicians and police officials who inspected on the way, at intervals of two to three hours, all the passengers. At the stations all passengers arriving and departing were likewise examined.

Those passengers traveling from Dairen by sea to other ports were examined closely as to the state of their health before the departure of their steamer, to prevent the outbreak of plague at other ports. Plague, however, appeared in Shantung, and particularly at Chefoo, and passengers from that port developed plague on the steamer during the journey to Dairen. Upon arrival of such steamer at Dairen all intercourse with the shore was prohibited and quarantine for seven days imposed upon ship and passengers. In other instances, where no cases on steamers coming from Chefoo had occurred, a seven-day quarantine was likewise required, but passengers were given the choice either to

remain on board or to stay ashore within the precincts of an isolation compound. These regulations concerning steamers coming from Chefoo were established at the end of February, 1911.

A SUCCESSFUL ANTIPLAGUE CAMPAIGN IN MEXICO

By Dr. O. GONZALEZ-FABELA

In compliance with the wishes expressed by the Hon. Alfred Sze on the opening day of the International Plague Conference, viz., "to keep the practical side of the subject in view," I am going to submit for your consideration how an epidemic of plague was rapidly checked and extinguished.

I will explain to you the general plan adopted which gave such satisfactory results, and some of the measures may perhaps be applied in other countries under similar circumstances.

During the latter part of 1902, bubonic plague, for the first time in the history of my country, made its appearance at Mazatlan, one of the ports on the Pacific coast which maintains constant communication with San Francisco. The disease became epidemic, but was limited and extinguished in two months by the measures put into practice.

As none of the medical practitioners at Mazatlan had ever seen plague before, the first cases were not recognized, a circumstance which favored the natural propagation of this disease so that it became epidemic.

When my Government instructed me, as bacteriologist of the Superior Board of Health of the Federal Service, to make the bacteriological diagnosis of the disease, I found a great number of patients, and I had no difficulty whatever in carrying out the isolation and identification of the plague bacillus after five days.

The general plan, carried out by my Government so successfully, was proposed and directly executed even in the most insignificant details by the board of health and especially by its president, the well known and highly reputed hygienist, Dr. E. Liceaga.

The population of the port of Mazatlan was about 18,000 when plague appeared, but decreased to 10,000 during the worst days of the epidemic. Out of 434 patients 335 died, the mortality being 77 per cent.

The first case probably occurred on the 20th of October, 1902, seven days after the arrival of the steamship *Curaçao* from San Francisco; the last on the 17th of March, 1903. The disease showed an epidemic character from the middle of December to the beginning of March. The bacteriological diagnosis was

established on the 3d of January, and the campaign against the epidemic began on the 15th.

Owing to the peculiar conditions of the public administration in my country, not only the Sinaloa State Government but also the Federal Government and all the people in the Republic contributed to the campaign.

The means of defense against the plague were the following:

1. Money.
2. Vaccinations.
3. Daily personal house-to-house inspection.
4. Isolation of the patients in a plague hospital.
5. Isolation in contact observation stations of the persons living in the infected houses who had been in contact with plague cases.
6. Disinfection or destruction by fire of the infected houses.
7. Disinfection or destruction by fire of all the clothes of patients and of suspected persons.
8. Medical examination of persons who intended to leave the port, in order to prevent the spread of the disease.
9. Quarantine stations in the localities through which the people had to pass to return to the country, with detention for ten days.
10. Destruction of rats.

To raise and distribute funds a committee of charity was organized at Mazatlan. This committee was able to collect within two months, through the aid of the state and private donations, the sum of $310,248 [about $155,124 United States currency]. The money spent was equal to about $1,000 [about $500 United States currency] on each fatal case.

The whole sanitary staff, from physicians down to the lowest employee, was vaccinated. Furthermore, vaccination was made compulsory for all the inhabitants of Mazatlan, and was applied to the greatest possible number of them. The total vaccinations done amounted to 15,260.

The vaccines used were Besredka's and Haffkine's, the last being prepared in the National Bacteriological Institute of Mexico.

The city of Mazatlan was divided into districts, each of which was put under the supervision of one physician. There were also several men instructed in the use of the thermometer and the general clinical examination of persons in relation to bubonic plague, so as to make daily house-to-house inspection possible. These men reported to the physician all cases which seemed suspicious; the physician subsequently examined these reported persons and ordered, if the cases were really plague, the following measures:

1. Isolation of the patient in the plague hospital.
2. Isolation in the camp of all persons living with the patient.
3. Disinfection of the house when practicable. If burned, compensation was made.

4. Disinfection of the clothes used by the patient and by those living in his company, or destruction by fire.

5. Distribution of new clothing among the above-mentioned people.

There were in the city of Mazatlan 4,263 dwellings (houses and huts) ; 1,060 of these were destroyed by fire.

The plague hospital was established on a small island and offered perfect conditions for isolation.

Camps for suspected cases were established far away from the crowded streets of the city, under police supervision. Besides new clothes, some money was distributed daily among these people for their meals, and when the quarantine was ended they received money for their needs for a few days.

In view of the importance of the details connected with practical disinfection, several experienced men were sent from Mexico City.

Clothes that were not burnt were disinfected by steam under pressure.

From the moment Mazatlan was officially declared a plague-infected port, free exit from the city was forbidden to its inhabitants, except for those who, after a careful medical examination, where provided with a certificate of health. For this special object several physicians were appointed.

In the quarantine stations a daily house-to-house inspection was established on the same lines as at Mazatlan. One group of disinfectors was attached to each of these stations.

The destruction of rats was carried out by distributing cultures of Danysz's bacillus and paying for rats that were delivered to the charity committee, about 14,000 being accounted for in this way.

The strict observance of these measures stamped out the epidemic at Mazatlan within two months. No other port was infected. In the interior of Sinaloa State three small foci appeared, but these were stamped out very quickly. My Government, which on the 3d of January had declared the port of Mazatlan plague infected, was able on the 16th of June to declare the port free from plague infection. I must mention that Mazatlan at that time was not connected by rail with any other place, nevertheless, on account of great emigration, there was much risk of spreading the disease.

Which treatment was the most successful? As a result of practical knowledge acquired in Mazatlan, the clinical study of the results of treatment could be better ascertained in one of the secondary foci, where the use of Yersin's serum by intravenous injections produced excellent effects. Out of fifteen patients submitted to this treatment only two died, a mortality far below

the average during the epidemic. These astonishing results may have been obtained only in the last cases when the virulence was dying out.

Finally, allow me to emphasize three points:

1. A sanitary cordon of soldiers was not used at Mazatlan.
2. Physicians and authorities were first vaccinated, so as to convince the people that this measure was indispensable.
3. Particular attention was paid to putting experienced persons in charge of disinfection work.

The following paper was then read on

THE CHANGCHUN EPIDEMIC

By TAOTAI HUANG PAO SHUN

Chief medical officer, Changchun Plague Prevention Committee

I regret to say that I have very little to offer for the study of the Conference. Owing to the heavy work entailed on a small staff of seven doctors, we had no time to inquire closely into the scientific points of the epidemic while it raged in Changchun. I will, therefore, confine myself to a statement of the actual work done.

Antiplague operations, always more or less difficult in every country when plague epidemics occur, were found especially difficult here at the beginning, owing to the want of knowledge on the part of the people as to the extreme seriousness of the disease and on the part of the officials who found themselves unprepared for an epidemic of such appalling virulence. As no living man has met pneumonic plague on such a wide scale as happened in north China, the lack of precautions by the sanitary authorities, which could readily be put into practice, was to some extent excusable. In addition to this the authorities were hampered in putting active measures into force by the resistance of people who found their self-interest involved.

Not only that, but the Chinese people believe in treatment according to the old system of the medical art. Modern hygiene does not hold a place in this system. Just as in Canton, Hongkong, Shanghai, and other ports of China the people resisted plague preventive measures, so also did the people in Manchuria, the majority of whom lead simple, rustic lives with little knowledge of the outside world. It was, therefore, even more difficult to impose measures of inspection and isolation on them than among the inhabitants of Shanghai and of other cities who are more familiar with foreign methods.

The local authorities first sought out local gentry of good repute and intelligence, and asked them to explain to the people

the plans of the committee for suppressing plague. In this way they hoped to lessen the difficulties caused by obstinacy and self-interest. The above method was adopted by the Changchun Plague Prevention Committee in the hope that the protests would be few and that the regulations could be easily enforced.

In plague-preventive measures the services of the police are of the utmost importance. It might be said that no effective action against the spread of the disease can be taken unless the police do effective work. The plague spreads from person to person, and it was found that poor and young persons mostly are subject to infection. This is due to the fact that the poor workmen of this place associated more freely than the better classes with the same class of men from the infected districts. Moreover the dwellings of the poor are small and crowded, and during the intensely cold weather the doors and windows are closed, allowing no fresh air to enter. Under these conditions infection is passed from person to person with the greatest facility. Old people and infants are not nearly so subject to this disease—a fact which we think worth noting. It is noticed also that when the weather becomes cold the death rate rises, and when the weather gets warm it falls. The conclusion we drew from this fact is that during the warm weather the people are more in the open air and are less exposed to the contagion of close, personal contact. Generally the incubation period of plague was three or four days. On the 27th of January the first case of septicæmic plague in the city of Changchun was reported by Dr. Chen. Some patients lived only a few hours after infection, while others dropped suddenly in the streets.

I was appointed director and chief medical officer of the Changchun Plague Prevention Committee, and on the 18th of January I took charge. Having an area of about 50 square li [17 square miles], including city, suburbs, and surrounding villages, and a population of about 100,000 people to look after, we at first had ten doctors, but when the plague attained its height in the first part and middle of February, three of the army doctors were recalled to their respective posts. With such a small staff we had no time to attempt scientific observations, and it is a great misfortune that we had not the opportunity to study the bacteriological and pathological aspects of the disease.

When the antiplague operations were first started, proclamations were issued stating the seriousness of the disease and calling on the people to submit to isolation and disinfection. At first the people placed no confidence in these measures, and the opposition of the native doctors of the old school was incurred. These latter believed that the disease could be cured and took

no precautions, and this ignorance resulted in the death of nine of them. Permission was reluctantly granted to the people to establish a plague hospital under native doctors of the old school in order to prevent them from creating further obstacles to our antiplague measures, but it was closed after being open for seven days, two doctors and seven nurses having become infected and died. The death of these doctors made a very great impression on the people, who came to understand the danger of the disease and have since taken proper precaution against it.

The plague was introduced into Changchun on the 2d of January by an infected merchant returning from Harbin. He died on the following day after having infected five of his shopmen, who all died in quick succession. This case, however, was not the only source from which Changchun became infected. As railway traffic was not stopped, men of the poorer classes and coolies from the surrounding infected districts were continually streaming in.

Some houses about five miles outside the city were leased and served as quarantine stations and refuges for the poor, and persons from the infected districts were temporarily detained therein and fed. Branch stations were established, and medical officers were engaged to carry out a daily house-to-house inspection.

We had two plague hospitals, including the one already mentioned in the hands of untrained doctors which only remained open seven days, a suspect hospital, seven contact houses, and three refuges for the poor. We divided the city, suburbs, and surrounding villages into seven sections, each section being placed under a foreign-trained doctor. Trained inspectors were dispatched to the different sections up-country to coöperate with the police in order to cope with the plague, and I am glad to say that the authorities and people worked harmoniously together, and eventually the plague was stamped out.

The activity of the epidemic reached its highest point on the 6th of February, the number of deaths in the city, suburbs, and surrounding villages that day being 140. The situation then gradually improved. The total number of deaths in the whole Changchun prefecture, reported from the beginning of the epidemic on the 2d of January to the 26th of March, was 5,818. The deaths among females was a little more than 9 per cent. Of the 1,214 patients admitted into the plague hospital, 1,201 died, and 13 were discharged who were not considered genuine plague cases. In the plague hospital the patients are arranged in different wards, so as to prevent suspected cases from coming into contact with actual plague cases, the symptoms of other diseases sometimes closely resembling those of plague.

When a plague area was located, communication was temporarily stopped and the adjacent streets, houses, courtyard, etc., thoroughly disinfected. This was done in Fu Yautien, Cheu Shen Chi Hutung, Tong Tzse Hutung, Kwang Yuen Tsan Hutung, Fu Haitien Hutung, Tien Chia Tai Yuen, Ho Se Chea, Yua Nou Chea, Lo Ting Tun, Taipingtun, Telingtun, and Chu Chia Tung, after disinfection had been properly carried out. In areas where numerous deaths previously occurred daily, no more cases were reported, except one or two which were traced to other infected places.

As the epidemic occurred in the winter and the ground was frozen hard, the burying of corpses was almost impossible and we had over one thousand coffins and corpses lying in the open, which had accumulated in about ten days early in February. This was very dangerous. It was afterward decided by the high authorities to cremate these corpses, the best possible method of disposing of them. Owing to the good offices of the local gentry, who understood the situation and raised no objection when consulted, the people did not actively oppose this method. The first cremation of 1,337 bodies was not quite satisfactory, but in the later cremations the bodies were burnt to ashes, which were properly buried. Altogether we cremated 4,643 and buried 1,175 bodies.

Of 320 of the burial corps 21 died; of 156 of the disinfecting corps 5 died; among the emergency corps of 120 there were 22 deaths recorded; moreover, at the plague hospitals 17 nurses became infected and died. At Lao Hu Kou, Changchun, 30 out of 91 grave diggers died in three days. We attributed this to the fact that they had been robbing the corpses of their clothing, etc., but this pilfering was afterwards prevented.

It is a noticeable fact, and one which I bring forward for your information, that up to the 21st of March 39 mules and horses, 5 dogs, and 4 pigs died, nearly all of which belonged to infected houses. My staff also reported that 5 mules, belonging to a plague-infected shop in which 3 human deaths had occurred, sufferred one after the other and died from sickness, which was marked by blood-stained mucus from their mouths. We fined the owners heavily for not notifying us.

During the epidemic we have burned 20 houses in the settlement and in the city. At the end of February the situation was markedly improved and we were pleased to find that the natives had taken to burying and burning their dead on their own initiative. The most important means of preventing the spread of the epidemic are general sanitation and cleanliness. Public places such as theaters, brothels, small inns, bath houses, barbers'

shops, livery stables, etc., should be under strict inspection. Schools should be closed temporarily. Public worshiping in temples and holiday processions should be stopped. Following is a list of a few of the preventive measures which we have undertaken:

All communications were cut off from infected districts.
Quarantine measures.
Cleaning a fifth of the city and suburbs.
Thorough disinfection.
Proper isolation.
Daily house-to-house inspection.
Accurate reports of deaths and insanitary conditions.
Preventing corpses being thrown into the streets.
Preventing access to corpses by dogs, etc.
Killing stray dogs and trapping rats.

The activity of the epidemic began to abate after the 15th of March, and on the 27th no deaths were reported from the city, suburbs, or from the villages in the prefecture. So we have been free from plague for eleven days, and we hope that this condition will continue. During the activity of the epidemic in February we received much valuable advice from Drs. Young and Gordon and also from the Russian and Japanese railway doctors. Dr. Uyama willingly gave his valuable service in training a disinfecting corps for us which did good work in the settlement. Dr. Hiremi was engaged by us to extend the training of the disinfecting corps and for other work, his services being very valuable. That the doctors could carry out plague-preventive measures without difficulty and ultimately be successful is mainly due to the good services of the local authorities, gentry, and merchants. My responsibility was not small, and, thanks to the energy and activity of my colleagues, Taotai Meng and Prefect Ho and my staff, we have at last brought the outbreak of plague to an end. Fortunately this calamity has been stamped out in time, and the minds of the Imperial Government, high officials, and the people at large are now at peace. Hereafter, I sincerely hope that the people may be induced to pay more attention to sanitation in order that they may be better prepared to meet a similar calamity in future, an occurrence, however, which we hope will not take place.

The next paper consisted of

EXTRACTS FROM A REPORT UPON PREVENTIVE MEASURES TAKEN AT FUCHIATIEN

By Dr. ASPLAND

January was the blackest month during the plague, and also the one of largest reinforcements. Dr. Wu and one student arrived

on December 21. On January 2, Dr. Mesny with three senior doctors and six assistants came, while Drs. Gibb and Fang with ten students of the Army Medical College arrived on January 4, and Drs. Aspland and Stenhouse with three students on January 18. Fourteen doctors came on January 26, and Dr. Hao with ten army medical students on January 28. Immediately the plan of campaign was discussed, and the plan of sectionally dividing the city was carried out and a new plague and new suspect hospital were opened. In order to carry out successfully this sectional cordon, it was necessary to relieve the police, who were doing cordon duty on the outside of the city, and this was made possible by the bringing up from Changchun of a regiment of 1,160 Chinese infantry, who were comfortably and suitably quartered in a large, empty Russian flour mill. The 600 police, thus placed in the hands of the Antiplague Bureau, were trained and instructed in their duties and then distributed to the four sections and quarantine stations under the direct control of the staff doctors. The buildings for the staff offices of each section were then prepared, and when the 800 coolies forming the actual working sanitary staff had been formed into companies and brigades the time had arrived for a forward movement. At this point a description of a section will be fitting: Let us, for example, describe section 4, the largest, under the administration of Dr. Sun. The disinfecting station and offices are in a large compound, previously used as a boys' school. The north building contains the office, with a long glass window partition running along one side, through which, at various small glass openings, letters, reports, etc., can be handed through by messengers who enter from the outside by a long passage. The reports, etc., are received by an office servant, who immediately immerses them in an antiseptic solution, and when they are dried, hands them to the officer on duty. After instructions are given, the report is filed when necessary. Adjoining the office is a sitting room in which, after duty, tea and refreshments are served. In the long wing running south all the medical officers and students, when coming off duty, enter by a door at the back on the large porch of which they are sprayed from head to foot with a solution of carbolic acid 1 in 40. They then enter the undressing room. The overalls, helmets, masks, and gloves are here removed, together with long boots and suits of clothes. Passing to another room the inner clothing is removed. In a state of nudity they enter the bathroom, first washing hands, face, and head with a solution of sublimate 1: 3000, and gargling the mouth and throat with an antiseptic. They then take a bath of 1: 3000 sublimate and pass from this into a plain-water bath

and on into a drying room, where they dress in their off-duty clothes. Of the infected clothes, such as can be washed are soaked in a sublimate solution and the others are fumigated with formalin and sulphur gas.

In a separate place a similar arrangement exists for the disinfection and bathing of sanitary coolies, police, stretcher bearers, and dead-cart attendants. All carts, ambulances, stretchers, and carriages are washed or sprayed daily with antiseptics, and the extent of the disinfecting work may be roughly estimated by the fact that, of pure carbolic acid alone, we used in Fuchiatien over 5,000 pounds.

The sectional division of the city was arranged in this manner: The four sections into which the city naturally divided itself were numbered 1, 2, 3, and 4, and every inhabitant in those sections was obliged, when out of his house, to wear a Government badge on his arm, corresponding to his district—that is, white, red, yellow, or blue. This badge permitted freedom of movement in his section, but a special permit was required before he could pass to another section. The same rule applied to the military cordon outside the city; none were allowed in or out without a special permit issued by the Antiplague Bureau. So that, with 1,000 soldiers on the outside and 600 police inside, it was almost impossible for anyone to pass the cordon.

The staff of a section such as No. 3 consisted of: One staff doctor, 2 assistant doctors, 4 students, 58 sanitary coolies (house disinfectors, house-searching parties, stretcher bearers, ambulance men, contact men, removers and buriers of dead), 12 carts for removal of dead, 16 stretchers, and 26 police.

The result of such effective cordon and sectional staff-work speaks for itself. In the month previous to its establishment the total number of deaths was 3,413, and at the time of establishment nearly 200 a day, yet on the thirtieth day after, the record of deaths was nil.

The Conference then adjourned until 2 p. m.

SESSION XIII, APRIL 18

PROGRAMME ARRANGED FOR THE DAY

D. Measures Employed to Combat the Epidemic.
2. Measures to be taken to limit the spread of infection in an infected town or village (continued).
a. Sanitary cordon to prevent ingress of possibly infected persons or goods.
b. Adoption of measures to limit the inter-communication of members of the community.
(1) Closing of schools, dispensaries, churches, theaters, pawnshops, inns, brothels, factories, laundries, etc.
(2) Stoppage of tramways, rickshaws, and other means of conveyance.
(3) Division of towns into sections and the segregation of the inhabitants in each section by the enforcement of quarantine regulations.
c. Education of the people, by means of public lectures, and the issue of pamphlets and popular bulletins.
d. The establishment of hospitals:
(1) For plague cases.
(2) For suspect cases.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Discussion of above programme.

PRELIMINARY BUSINESS

Dr. Wu took the chair at 2.15 p. m.

The Chairman said that the Conference would now discuss Section D of the programme—i. e., "Measures employed to combat the epidemic." There had been a paper that morning on Subsection D 1.

Dr. Aspland said that he would like to remind the Conference that at the beginning an alteration was made in the programme, that the word "past" should be inserted all through before the word "epidemic." If that were remembered and observed it would simplify matters, as a great deal of matter had been introduced recently which had nothing to do with the past epidemic.

The Chairman said that it seemed to him that Subsection D 1 would take at the most fifteen to twenty minutes to discuss, and, although it was

not included in the programme, perhaps the Conference would like to deal with it at this session and take evidence as to whether, and if so what, protection had been conferred by plague vaccines and sera in pneumonic plague.

Dr. PETRIE said that he supposed that there was no evidence upon that point as far as was known.

Dr. STRONG said that the papers read at the morning session had been on Subsection D 2.

The CHAIRMAN said that there had been one paper upon Subsection D 1 d, by Dr. Woo.

Dr. STRONG remarked that that was not originally upon the programme, and therefore ought not to have been read at that session.

Dr. FARRAR moved that the Conference proceed to the discussion on Subsection D 2.

Dr. STRONG seconded this proposal.

The CHAIRMAN. We do not seem to be very clear about this. Is it desired by the Conference that the committee appointed already should decide all these questions regarding prophylactic inoculations or that these five points should be discussed by the Conference?

Dr. STRONG thought that an opportunity should be given for special papers upon these subjects.

DISCUSSION OF PROGRAMME

The CHAIRMAN said that after what had been said the best thing to do would be to put Subsection D 1 down for discussion the following morning and proceed with D 2 a, *Sanitary cordons to prevent ingress of possible infected persons or goods.*

Dr. FARRAR said that he had no special information upon this point, but he thought it ought to be put on record that in the opinion of the Conference a sanitary cordon was necessary in time of plague to prevent ingress of possibly infected persons or goods.

Dr. GRAY. That is a recommendation.

Dr. FARRAR. I merely say it is a good thing.

Dr. GRAY said that he was very much interested in Dr. Iasienski's paper [see p. 217], but he did not gather altogether the reason why, when a definite focus of pneumonic plague was found in the region of Manchouli, infection was allowed to spread in such a wholesale fashion to Harbin. They knew, of course, that the infection was spread by returning coolies. They also knew that the Chinese Eastern Railway, on its eastern section, had a very efficient staff of competent doctors especially attached to the railway. It would, therefore, be rather interesting to hear more from Dr. Iasienski, in a little more detail, in what way infection came so freely to Harbin, without being stopped en route to the west of that place.

Dr. ANDREW said that, with regard to the question of a sanitary

cordon to prevent ingress of possibly infected persons or goods, there were two questions that he would like to ask. The first was from the Russian authorities here, as to their opinion as regards the efficacy of the cordon placed round Fuchiatien in the latter part of December last year, and exactly to what extent they found it of use. The second question he would like to ask was the opinion of the local Chinese authorities on the efficacy of the cordon placed on the Great Wall of China, he thought toward the end of February. He had recommended this measure early in January before a single case had come south, and he would like to know the opinion of those who had actually been working as to the efficacy of these cordons.

Dr. CHABANEIX said that he did not think that any cases of plague got through after the cordon had been placed upon the Great Wall in January. All cases that occurred in Chihli entered by the railway between January 8 and 15.

The CHAIRMAN said that with regard to Dr. Andrew's questions his first inquiry should have been addressed to the Chinese commission, because it was the Chinese commission that placed the cordon around Fuchiatien. It began on February 2, and was withdrawn a month after the last case was reported. It was found very effective.

Dr. IASIENSKI said that he desired to answer Dr. Gray's question why the disease was allowed to spread to Harbin and whether the measures taken in Manchouli were not sufficiently effective. He desired to point out that, at first, there was no quarantine at Manchouli station and other stations, but only medical inspection, as he had already pointed out in his paper, so that it was possible for infected persons to get through during the period of incubation, when it was impossible to recognize the sickness. It had not been established that the disease spread to Harbin by railway only because, when stronger measures were adopted on the railway, traffic along the roads increased. The disease could just as easily have been brought to Harbin by road from Tsitsihar or other places.

Dr. STRONG said that he would like to ask Dr. Wang if he would furnish the Conference with some further data with regard to the epidemic in Mukden. He would like to know the total number of cases that occurred here, the mortality, and so forth, which had not been given in Dr. Wang's paper. He had looked through this paper, and found that it only gave the mortality in certain districts. He thought that there ought to be a more complete report of the Mukden epidemic for the Conference records.

Dr. WANG read the following figures in regard to the epidemic at Mukden. The deaths were:

In hospital	458
In merchants' hospital	251
In houses	669
On streets, etc	319
Total	1,697

The figures of the staff were as follows:

	Number of deaths.
Out of 45 doctors	1
Out of 50 nurses	9
Out of 18 officers	1
Out of 120 police	2
Out of 200 coolies	8
Total (433)	21

Dr. CHRISTIE said that the importance of educating the people had been very much emphasized in the villages around Mukden. If more importance had been attached to educating the people earlier in the epidemic, many of the difficulties that occurred would never have arisen. As soon as they got leaflets printed in simple language and scattered about all over the country, splendid results followed. There were scores of villages around Mukden where the disease never entered in consequence of these leaflets. He thought there should be a great deal of praise for the intelligence of the people in this matter. Without any help from outside they established cordons around their own villages, and prevented anyone from going out or coming in without the permission of the headman of the village. In many villages these precautions had been carried out with splendid results. The villagers combined and sent men into Mukden with carts to get their supplies, and these men were not allowed to come into touch with the life of the city, but, after getting their supplies, had to return immediately. He thought the Conference could not emphasize too much the importance of educating the people, and that the intelligence of the Chinese people had come out splendidly in connection with the country around Mukden.

Dr. PETRIE said that he would be interested to know whether the cordon around Fuchiatien and other towns operated by day and during the night as well. He supposed that it operated continuously. He would also like to know the distance between individual members of the cordons. He did not know whether Dr. Andrew's question had been answered, whether a cordon

was really found effective in preventing the escape of persons from towns and villages or their ingress from other centers.

Dr. LEWIS said that since it was found that people walking overland were able to carry infection for great distances it might be asked whether it was not considered good policy to continue railway traffic and keep it under strict surveillance, rather than to stop railway traffic and allow infection to be carried across country.

Dr. ASPLAND said that that was a question which would come under the head of resolutions. He was afraid that it was out of order at this stage. With reference to Fuchiatien and the military cordon there, he did not know whether the exact figures of the soldiers at their disposal were available, but he could say that the soldiers were divided into four sets, doing four hours' duty in turn during the twenty-four hours. They were supplied with rough sheds, a kind of military box, with a room inside where the men could be protected from the weather. One or two men were on duty at each post at the same time. These posts were situated at various points all around the city. Anyone who knew the limited size of Fuchiatien would realize that there were no spaces of more than fifty to one hundred yards that were not patrolled. Anyone who said that a patrol or cordon system was perfect would be wide of the mark. By stealing a badge, or giving a tip, a man might be able to get through. But those who got through were a very small percentage of the population, and, as far as a cordon could be perfectly carried out, he thought it was carried out at Fuchiatien. He thought that there was a point in the programme which ought to be referred to. The programme referred to ingress. But egress from an infected district was just as important. In one large town, he believed it was Asahor, the people were allowed to leave in unlimited numbers, but no one was allowed to enter from outside. He thought that this was an important point in connection with cordon work.

Dr. CHABANEIX said that he would like to point out to the Conference that if a sanitary cordon was possible around a small town it was absolutely impossible around a large one.

The CHAIRMAN said that perhaps Dr. Chabaneix could give some information with regard to the cordon on the Great Wall.

Dr. CHABANEIX. Since the 27th of January the Great Wall, from the sea to the mountains, was guarded by 750 Chinese soldiers. The watch was very easy to perform, both by day and by night, owing to the small number of outlets. Not a single case of plague had been reported as getting through the Great Wall. All the cases with which Pechihli and Shantung had to deal origi-

nated from persons who had come from Manchuria by railway between January 8 and 14. I should like to add that the most important of the quarantine measures was not the sanitary cordon on the Great Wall, but the restriction of passenger traffic on the railway, which was put into force against persons from Manchuria on January 14.

The Conference then proceeded to discuss Subsection D 2 b (1)–(3).

Dr. GONZALEZ–FABELA suggested that the best course for the Conference to adopt with regard to this part of the programme would be to appoint a commission of three or four Delegates to consider these questions, and to draw up resolutions upon them which could afterward be submitted to the Conference for discussion. The recommendations of the Conference were the most important part of its work, and he did not consider that discussion of these points in the full sessions was useful. If a committee were appointed and made recommendations, the latter could be discussed. This, he considered, would be the best method.

Dr. CHRISTIE said that he sympathized entirely with the last speaker in regard to this matter. He could not say in what form his suggestion should be carried out. It seemed to him that the Conference was not giving attention to many very important questions. The Conference had spent a great deal of time upon bacteriology, but, after all, the Chinese Government was not so interested in that as in practical measures for preventing the spread of the epidemic. It was quite possible that the disease could be conveyed by rickshaws, tramways, and other vehicles, an exceedingly important question. In Mukden and other places the question had arisen whether traffic ought to be stopped altogether. That would be a very serious step. These were questions upon which in his opinion the Conference must decide something definite to lay before the Chinese Government.

Dr. ASPLAND said that these sessions were for the purpose of receiving evidence and not for appointing committees to make recommendations. The Conference wanted to know from every man engaged in plague work what he did, whether he sterilized rickshaws, etc., and if not, whether it was wise to do it or not. The Conference was seeking to get information upon these points.

Dr. CHRISTIE said that the question of rickshaws had been a very difficult one in Mukden. At a very early stage of the epidemic it was found that the disease was very prevalent among carters and rickshaw coolies. Doubtless this was caused by the fact that there were many cases at the railway stations, where

the coolies gathered in large numbers to obtain passengers. What ought to be done? Ought the traffic to be limited or only controlled? It was almost impossible to stop it entirely. If that were done how were the coolies to exist without having work? To limit it too would present very great difficulties. It was therefore decided to disinfect the rickshaws. A statement had been made at the morning session that that was quite useless. They had spent a great deal of time and money in disinfecting them. The rickshaws were systematically disinfected, and had to carry flags to show that they had been disinfected and were free from infection. Was that work quite useless, and was nothing to be gained by limiting the traffic in any way? He thought these were very important questions which ought to receive serious consideration.

Dr. PETRIE asked how the disinfection of rickshaws was carried out.

Dr. CHRISTIE replied that it was done by the police, who cleaned them out and fumigated and disinfected them, as well as by the rickshaw coolies.

The CHAIRMAN (Dr. WU). With regard to Subsection D 2 b (1), *the closing of schools, etc.*, I have some information of interest to impart. The schools were closed about a month after the epidemic started in Fuchiatien. In regard to dispensaries, I suppose that a lot of men, when they were infected, went to the Chinese drug shops, and thus infected men behind the counters. Regarding churches I have a very sad story to tell. There is one Roman Catholic Church in Fuchiatien with a community of a little over 300 people. When plague started, even before I went there, the authorities told the Roman Catholic priests that they had opened a hospital to which converts must be removed when they became plague infected. The priests refused to allow this, saying they had a Western doctor of their own. Two weeks afterward about 100 people were reported to be dead. In the end, just after one month, 243 persons out of a little over 300 in the community died. They were removed to a separate field. About 27 coffins were found inside one compound. I had great difficulty in getting consent to remove these bodies and burn them. In the end the priest consented, and the dead were cremated. The strangest thing of all was that during the epidemic, services were held in the usual way. Men went to prayers at any time in the day and helped to spread infection. In the end the French priest and all his assistants died, so that no one was left to look after the church except a few coolies. A good many people got infected at theaters in spite of

the precautions that were in force when I arrived there. After much trouble the theaters were closed. This was found to be most satisfactory. A good many persons in pawn shops were also infected. It is very hard to say whether they were infected through clothing or not. There was much infection in the inns. In the brothels, strange to say, out of 300 women employed, only two died, although more than ten of their customers were found dead of plague inside the houses.

Dr. GRAY said that, with regard to the *disinfection of rickshaws, tramways, and other conveyances*, Dr. Kasai had told them something about that in a paper read some days ago. He [the speaker] had an opportunity of seeing the regulations at Dairen; they seemed to be drawn up in a model way and upon a most efficient scale. As regards schools it would be very interesting to know if the board of education took any general measures to make regulations dealing with the subject of schools in Manchuria at that time, or whether they left it to the initiative of each town to deal with the question.

Dr. FARRAR said that, with regard to the closure of inns, it seemed to him that that would not be desirable at all, as it would scatter people who would otherwise congregate in them. If inns were closed, enormous numbers of coolies traveling for the New Year would have to go to private houses and would thus infect large numbers of private families. At Chefoo, of which he could speak from personal observation, very few cases occurred in private houses. Nearly all occurred in the inns. If the inns had been closed undoubtedly more cases would have occurred in private houses, because the coolies would have been necessitated to take refuge with any one who would take them in. Inns should not be closed, but should be carefully guarded and inspected every night.

Dr. CHABANEIX. I can tell what has been done in Tientsin in regard to the *closure of schools*. When the epidemic occurred it was during the Chinese New Year holidays, and the schools were closed. The opening could not take place at the usual time, but was delayed for a month, and took place at the end of February, when the epidemic had decreased. Scholars from infected places were admitted into Tientsin, but isolated in large schools for seven days, and at the expiration of the seven days were vaccinated against plague.

Dr. CHRISTIE stated that the board of education in Mukden took steps at an early stage to close all the schools. They were only opened last Saturday. This regulation was strictly enforced throughout. There were over 3,000 pupils in Mukden,

and none of them contracted plague to their knowledge except one female student, who died at home.

Dr. STRONG asked Dr. Chabaneix whether any of the Tientsin pupils contracted plague.

Dr. CHABANEIX replied that not one pupil contracted plague at Tientsin, but added that the town was never seriously infected.

Dr. PETRIE suggested that it would be interesting to hear from Dr. Kasai more about the rickshaw regulations in Dairen referred to by Dr. Gray.

Dr. KASAI stated that in Dairen during the epidemic coolies were not allowed to enter rickshaws or tram cars. Both cars and rickshaws were disinfected with a carbolic-acid spray.

Dr. ASPLAND said that he would like to ask some of the Russian doctors what measures they took in relation to their factories at Harbin. A great many of them were kept open and he believed they had used measures to keep their coolies in their own compounds.

Dr. IASIENSKI replied that in Harbin, in the workshops of the railway as well as in the big flour mills, their workmen were kept in compounds, at each of which special doctors made a daily inspection of the coolies and took their temperatures. That was about all that was done, except that at the flour mills they were also vaccinated.

Dr. ASPLAND asked if these men were all kept in the compounds of the flour mills and were not permitted to leave them.

Dr. IASIENSKI. Yes.

Dr. ASPLAND. Can you give us any statistics as to the death rate among them?

Dr. IASIENSKI. I can not answer that question now, but at the next session I shall probably be able to give the figures.

Professor KITASATO stated that he wished to speak about rickshaw disinfection at Dairen. It sometimes occurred that in Dairen corpses were transported in the nighttime in rickshaws. In these cases the rickshaws were disinfected. In his opinion there was no necessity in ordinary circumstances to disinfect railway carriages, tram cars, or rickshaws.

Dr. CHRISTIE stated that there was one case in which he saw a man dying in a rickshaw. The floor of the rickshaw was covered with his sputum.

Dr. GRAY stated that the reason he asked about rickshaws was because in Tientsin a man with blood-stained sputum was discovered by one of the assistants of the sanitary staff in one of these vehicles, from which he was taken. The sanitary assistant lost his life. The man himself died shortly after being removed from the rickshaw.

Dr. CHABANEIX stated that he could say with certainty that this rickshaw was disinfected. Every time a case similar to the one recounted was brought in, the rickshaw was disinfected.

Professor KITASATO. In such cases, of course, the Japanese would also disinfect rickshaws.

Dr. CHRISTIE said that Chinese carts were still more dangerous because many of them carried cuspidors. Often plague patients had been hidden away in these carts and were found dead in them. One woman was found dead in a cart 20 li [7 miles] to the south of Mukden. He thought that a cart was more dangerous than a rickshaw.

Dr. LEWIS stated that in one case he knew of a man who had been riding all day in a Chinese cart; this man was expectorating blood. The next morning he died. A search was made for cases infected by this cart, but no cases could be traced to it at all. In that particular case there was no infection from the cart. However, he thought that anybody knowing of such a cart would disinfect it.

Dr. PETRIE asked if the cart gave infection to the man.

Dr. LEWIS replied that the man was infected somewhere in Manchuria, and rode from the station to his home in the cart. He died the next morning. The village from which the cart came was searched, but no case of plague was found in that district, so that no one was infected from that cart although this man had been in it all day. The carter himself was not infected, but that might easily be explained, for if there were an east wind and he were driving south he might probably have walked on the left side of his cart and the wind would then be driving the infection from him.

Professor ZABOLOTNY stated that during the epidemic at Odessa suspected carriages were, of course, disinfected either with carbolic acid or with izal or carbolic acid and soap. He thought that izal was preferable to carbolic acid.

Dr. PETRIE asked if there was any restriction of business in a badly infected town like Fuchiatien. If people went freely to shops, the shop keepers would stand a very much greater chance of being infected.

The CHAIRMAN (Dr. WU) said that Dr. Farrar had mentioned the question of inns. Half of the inns used by the coolies at Fuchiatien were infected from the very beginning so that it was found necessary to exercise the greatest possible supervision over them. Then in regard to vehicles, there were no rickshaws in Harbin, but carriages drawn by two ponies were mostly used. There was no doubt that a large number of cab drivers died from plague. He had very often seen blood-stained sputum frozen

on the steps of these carriages. One wondered whether it would be necessary to take special precautions against these public carriages, especially against those in Harbin during the cold weather.

Dr. STRONG asked just what the Chairman had meant when he said that the inns were infected.

The CHAIRMAN replied that many people died in the inns even before he went there.

Dr. LIU said that he would like to give an account of what measures were taken in regard to mule carts and carriages on the way to the city of Kirin. A quarantine station was placed about 20 li [7 miles] away from the city. Anyone passing it had to be kept in quarantine for five days. Three suspected cases were found, and these were immediately sent to the plague hospital. As regards measures taken with carriages, those which came from Kuanchengtze were sent back. In the three suspected cases the carriages were also kept for five days before they were allowed to go back to Changchun. These carriages were thoroughly disinfected with sublimate and sulphur. In their experience they did not find a single case of plague which had passed through this station after it was opened. The effect of this quarantine station was obvious. With reference to the students, a very large number of them entered the city. They also were kept in quarantine for five days. It was found that some of them tried to evade quarantine; therefore, a rule was enforced necessitating the receipt of a certificate from the general quarantine station before any student was allowed to enter a school.

Dr. ASPLAND said that in closing the discussion upon this section he would like to ask a question in relation to laundries. In Fuchiatien the foreigners had found it very difficult to get their clothes washed, owing to the mere fact that they were engaged on plague work. He would like to know whether the Russians had taken any action in regard to laundries.

Dr. IASIENSKI said that in regard to laundries the town of Fuchiatien was divided into districts each under the supervision of a doctor. These doctors made a daily inspection of private laundries. The proprietors and employees were examined and had their temperatures taken. Later a large laundry was opened for the public where everyone could have clothes washed under foreign supervision. In the observation stations and plague hospitals there was always a means of washing the clothes of those who passed through. People under observation also had their clothes cleaned. The clothing of the workmen from the

railway workshops was also kept clean. The efficiency of these measures was shown by the fact that not a single death occurred among the private European population of Harbin.

The CHAIRMAN said they would now pass on to the next section, namely, *Education of the people, etc.*

Professor ZABOLOTNY said that these lectures to the people and the distribution of pamphlets and popular bulletins were very important measures. They were especially good as measures of prevention. For instance, when vaccinations were to be done their use was demonstrated. In Harbin the people were very well instructed after a few weeks. They understood the use of vaccination and voluntarily came to be inoculated. The people in general were not yet accustomed to such measures, and it was necessary that they should be well informed on these subjects.

Dr. ANDREW said that, with reference to what Professor Zabolotny had said, he would like to give his own experience in regard to the handling of large masses of coolies in the carrying out of preventive inoculation. In 1909 he thought that he was probably the first person in north China to undertake preventive inoculation upon a large scale and all his work was carried out among the lowest class of coal coolies. When he suggested that such a thing should be done, foreigners rather laughed at the idea, saying that the Chinese coolie would never submit to a needle being put into his arm. He must say that after he had started, things went very easily indeed. He had practically no difficulty in inoculating 5,000 coolies. He had come to the conclusion that it was very important to carry out such work in public and not in private, so that all could come and look at it and see how simple an operation it was. He carried out all the work in an open shed with no front wall to it. During the time that he was sterilizing the syringe and getting ready, his assistant delivered a lecture to the curious coolies on the efficacy of the measures. Three to four days after he had started he had them in such a state of enthusiasm over inoculation that he had to get the assistance of three to four policemen to aid in keeping them back. Another important practical point was that, in dealing with the coolie class which lived a hand-to-mouth existence, it was not fair to inoculate them unless some compensation was made for the fact that for two days they would probably be unable to work. They could not expect a coolie to come forward and be inoculated when he had to lie on his back for two days without anything to eat. Later on, when the time came for suggestions to be made, he would recommend that in the case of the coolie classes every coolie should be paid at least

two days' wages when he received inoculation. This measure had been carried out in India, and he thought it ought to be done here.

Dr. BROQUET said that they ought to use vaccination for smallpox, and as soon as the natives got to know that smallpox inoculation prevented them from getting the disease they would become used to the idea, and, finding what benefits they derived from that form of inoculation, they would be in favor of any other form of inoculation which might be necessary. This had been tried in Indo-China with satisfactory results.

Professor ZABOLOTNY said that they had had the same experience in Astrakhan as Dr. Andrew had described at Tongshan. In Astrakhan they had inoculated 4,500 workmen. First they gave lectures to the people, then they made demonstrations by inoculating themselves and got the workmen to organize themselves to keep order. Finally, the workmen helped in handling and washing the necessary apparatus, and so forth. He considered that coöperation of the people was an important factor.

Dr. HEHEWERTH said that in Java, although vaccination against smallpox had been largely carried out, it had not helped when they came to vaccinate the people for cholera. They found that the men would not come forward, and he did not consider that because people were used to one kind of vaccination they would as readily submit to another.

Dr. CHABANEIX. In Shanhaikuan we have been trying to educate the public by proclamations, meetings, etc. In Tientsin the same thing has been done. Four thousand vaccinations were done free of charge. Each time a man was vaccinated a certificate was given to him saying that he was inoculated on such and such a date and indicating on the reverse side the symptoms he might expect from the reaction. Dr. Andrew had said that the workmen in Tongshan were enthusiastic with regard to antiplague vaccination, but I think it is more likely that their apparent enthusiasm for vaccination was really for the 30 or 40 cents given to each of them as compensation for loss of wages during the one or two days' indisposition.

Dr. FARRAR said there was one subsidiary point in regard to vaccination. Each man vaccinated should receive a certificate and, as in India, should have his thumb mark impressed upon the ticket given to him so as to prevent impersonation.

Dr. WANG stated that a daily plague newspaper published in Mukden was distributed among the people. It was the first of its kind ever issued.

Dr. CHRISTIE stated that this newspaper published full statistics for the whole of Manchuria and much information about the epidemic as a whole.

Dr. STRONG suggested that the difficulty was that frequently the people who needed it most could not read.

Dr. CHRISTIE said that it was published in very simple Chinese so that nearly everyone could read it.

Professor ZABOLOTNY said that Dr. Bogucki, who had charge of the question of night refuges, stated that he had arranged so that lectures about plague and its danger were given almost daily in these refuges and inns.

Dr. CHUNG stated that when the plague was in Kirin many people came to the antiplague bureau for inoculation. At that time they had very little vaccine, having used nearly all of it and many people were disappointed who wanted to be vaccinated. Later on, when they received a large supply from Dr. Andrew, which came very late, he asked several persons if they wanted to be vaccinated, but they had heard that Dr. Jackson had died after being vaccinated twice and their confidence was shaken. He thought that they should instruct the people that these methods of prevention were important and that a case such as that of Dr. Jackson might be an exception.

Dr. CHRISTIE said that he would like to say that Dr. Jackson had only been vaccinated once, thirteen days before he died, with vaccine left by Dr. Andrew. This vaccine was stated on the bottle to be two years old. It gave very little reaction in his case. The very next morning Dr. Jackson accompanied him to see a plague case in the city. He had some fear that the inoculation had had no satisfactory effect because there was no reaction. In the hospital he had vaccinated over 700, of whom 40 were foreigners. The symptoms were very much the same as have already been stated. Only seven of those vaccinated were employed in direct plague work. None of these died. The others did not, so far as he knew, come into contact with the disease at all and, as far as he was aware, there was no death among them.

ESTABLISHMENT OF HOSPITALS

Dr. BROQUET said that, from what he had seen in Manchuria in hospitals quickly constructed during the epidemic, the wards in which the sick were placed did not present those conditions which should be considered indispensable to people suffering from pneumonia. Very often the wards were so cold that the sick

persons themselves got up to add fuel to the fire, the temperature in the room often being below zero. Such conditions would be likely to mitigate any possible benefits from serum-therapy. Now that it was known that doctors and helpers could protect themselves against infection by the use of masks, plague patients should be cared for as ordinary sick people. The time was past when the people could be left to die in their own houses or even of hunger. It was no longer a time when the plague-stricken could be looked at only through opera glasses, or when no one was willing to go close to them to nurse them. Henceforth plague patients should no longer be objects of fear but, on the contrary, objects of pity, and it was necessary that the most attentive nursing should be given to them. Nor was it necessary that piles of coffins should be the first thing to meet the eyes at the doors of the hospital. He knew very well how difficult it was to engage helpers to nurse plague patients. The Russian doctors at Harbin had been the first to recognize that their personnel was often composed of undesirable characters, who were even guilty of robbing the dead and the sick. One could imagine what sort of aid such a class of helpers would give to the sick. Therefore, it seemed to him necessary that those who nursed plague cases, even more than those who nursed other diseases, should be intelligent, devoted, and well-instructed helpers, who could be relied upon to assist the doctors in every way possible. It could not be denied that they should be well remunerated.

Dr. FARRAR said that he thought that what Dr. Broquet had said was of the utmost importance. In this connection it was only fair that they should recognize that the only hospital, according to his opinion, conforming to modern requirements was the hospital at Dalny. One knew, of course, that the disease came so suddenly in the recent epidemic that it was impossible to organize hospitals in accordance with modern requirements, but it was significant that the hospital in which the most modern kind of provision was made was the only one in which cases of recovery occurred.

Dr. GRAY said he thought that Dr. Broquet and Dr. Farrar had not quite appreciated the difficulties under which the hospitals were built. In Changchun the ground had to be soaked with hot water in order to erect the simplest huts. When the foundations were prepared there was a fall of snow, and they had to begin all over again. In North Manchuria it was almost impossible to erect anything but small "tin" huts. Any building possible had to be put up in order to get the plague-stricken people isolated.

Dr. FARRAR said that he quite realized the impossibility of being prepared owing to the suddenness of the epidemic. He only meant to infer that hospitals should be in readiness for the next epidemic if it occurred.

Professor ZABOLOTNY said that he considered that the question of hospitals was a most important one and that in each town there should be at least one hospital for infectious diseases. He agreed with Dr. Broquet that patients treated in a properly equipped hospital had a better chance than those put into temporary buildings. Naturally, it was difficult to provide for the sick in places where there were no hospitals when a sudden epidemic of this kind appeared. In his opinion there were three points for consideration: (1) The building of hospitals, (2) the provision of nursing appliances and hospital fittings, and (3) the question of attendance on the sick. Special hospitals should be constructed for infectious diseases. In the recent epidemic it was undoubtedly true that many of the buildings used as hospitals were far from perfect. As to the personnel, it was well known that the nurses were not all that could be desired, but measures were taken to remedy this. He considered that only trained nurses should be used in these hospitals. The question as to how the sick should be nursed was a very important one. He quite agreed with Dr. Broquet that no distinction should be made between plague patients and those suffering from other infectious diseases, and he was sure that all of the Delegates would be of the same opinion.

Professor SHIBAYAMA said that he quite agreed with Dr. Broquet in demanding that plague hospitals must be well built. It was also most important that these hospitals should be rat proof. In Mukden a rat had been found in a room with a patient; fortunately this rat was not plague infected. In Japan they had special regulations. Plague hospitals must be protected by corrugated iron against rats, and they must be thoroughly rat proof.

Dr. STRONG said that he quite agreed with those who had spoken before him upon the great importance of the proper construction of hospitals for pneumonic-plague cases. He considered that they should be constructed upon the "box system" where there was individual isolation. Where patients were exposed every day to reinfection, as they had been in this epidemic, there would be probably little hope of recovery even if treatment was partially effective. Most of the cases of plague in this epidemic were exposed every day to reinfection from fresh cases brought into the hospital.

Dr. CHRISTIE said that it would be a very great help to the

Government if some directions were given by the Conference in regard to hospital construction. There was one very important question, and that was the amount of cubic space allowed for each patient. In England he believed it was 2,000 cubic feet for noninfectious diseases and 3,000 for smallpox patients.

Dr. STRONG repeated that it was his opinion that the hospitals should be composed of separate rooms or of wards in which the patients were separated by partitions.

Dr. HAFFKINE said that he wished to state his views in regard to plague hospitals. The wards for those sick with plague should be big rooms and they should be provided with ideal ventilation, impenetrable walls, and floors painted with oil paint. In isolation hospitals there should be small rooms, so that individual isolation of patients could be effected. These arrangements should be available beforehand. Experience had shown that Chinese assistants were very good for nursing the sick. Lastly, it was desirable at once to organize schools where the medical staff and assistants could be educated to prepare for future epidemics.

Dr. STRONG asked whether it would not be well to consider the appointment of committees to consider the framing of the resolutions of the Conference. The programme could be divided and a number of committees could be appointed to begin to consider the resolutions, so that when the time came for making resolutions these committees would be ready to present something for the Conference to discuss and decide upon. He suggested that this matter should be considered the first thing next day, and that there might be different committees. He thought perhaps one committee upon the bacteriological section, one upon the clinical, and another upon the epidemiological might suffice. This was only to facilitate the passing of resolutions when the Conference came to them. Such a question as that which had just been discussed—the construction of hospitals—was a matter which would have to be considered before recommendations were made.

The Conference then adjourned until the following day.

SESSION XIV, APRIL 19

PROGRAMME ARRANGED FOR THE DAY

D. Measures Employed to Combat the Epidemic.

1. Prophylactic inoculations with vaccines and sera.
   a. Evidence as to protection conferred by plague vaccines against a pneumonic infection.
   b. Evidence as to hypersusceptibility to infection immediately following inoculation with vaccine—the negative phase.
   c. The comparative immunizing properties of vaccines prepared from "rat" strains, "human bubonic" strains, and "pneumonic" strains.
   d. Local and constitutional effects produced by vaccines and sera obtained from different sources.
   e. The value of antiplague serum as a prophylactic either given alone or with vaccines.
2. Measures to be taken to limit the spread of infection in an infected town or village (continued).
   d. The establishment of hospitals (continued):
      (1) For plague cases.
      (2) For suspect cases.
   e. The establishment of quarantine camps:
      (1) Contact quarantine camps.
      (2) Segregation camps for certain classes of the community and for immigrants.
   f. Notification of sick persons and corpses found in houses or streets and of coffins sold; house-to-house visitation.
   g. Means of disinfection:
      (1) Disinfection of plague houses and articles suspected of being infected, including the burning of houses.
      (2) The efficacy of various disinfectants (lime, carbolic acid, perchloride of mercury, sulphur fumigation, and formalin) and the comparative value of various methods of disinfection, with special reference to the difficulties encountered in disinfection work, owing to the severe climatic conditions prevalent during the epidemic.

h. Methods of removal and disposal of plague corpses.
i. Organization of the sanitary staff.
j. Precautionary measures to be taken by those attending on the sick, or concerned with the removal and disposal of the dead—e. g., inoculation with plague vaccine; baths; masks, goggles, overalls, gloves, etc.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Discussion regarding the negative phase following inoculation.
3. Individual precautions taken by the medical staff during the recent epidemic at Fuchiatien.
4. Discussion regarding protection afforded by glasses.
5. Discussion on the establishment of hospitals for suspect cases, etc.
6. Discussion regarding notification of sick persons and corpses found in houses or streets, etc., and of coffins sold; house-to-house visitation.
7. Discussion regarding means of disinfection.
8. Discussion regarding removal and disposal of plague corpses.
9. Discussion regarding precautionary measures for those attending the sick.

PRELIMINARY BUSINESS

Dr. WU took the chair.

The SECRETARY. The following telegram has been sent to Gen. Viscount Oshima at Port Arthur:

"The Delegates of the International Plague Conference and all those who have had the honor to be entertained express their grateful thanks for your kind hospitality and assure you that their visit was thoroughly enjoyed."

The following telegram has been sent to President Nakamura of the South Manchuria Railway, Dairen:

"The Delegates of the International Plague Conference and your guests wish to express their great appreciation of your kind hospitality and for all the arrangements made for a highly instructive and enjoyable excursion."

The minutes of Sessions XII and XIII were accepted.

The CHAIRMAN. When we adjourned yesterday afternoon, Dr. Strong intimated that he desired to raise the question of the appointment of committees at this session.

Dr. FARRAR. He has agreed to postpone that question until to-morrow. The suggested scheme and suggested rules of procedure and of committees are being provisionally drawn up and will be put before the Conference to-morrow.

Dr. ASPLAND. May I ask by whom they are being drawn up?

Dr. FARRAR. By several people, and they are tentative only.

The CHAIRMAN. In that case, if the Conference agrees, we will pass on to the programme of the day, Subsection D 1.

Professor GALEOTTI. I think that the points of this section have already been discussed, not only by the Conference but also by the vaccine subcommitte, and, therefore, I think it is unnecessary to renew the discussion on this difficult subject. For instance, we have already fully discussed Subsection D 1 a. On this point a resolution has already been drafted by the committee. Subsection D 1 e has also been fully discussed.

Dr. ASPLAND said that in order to save time, and on a point of order, he might remind the Conference that it had been decided the preceding afternoon that Subsection D 1 should be discussed at this session. It was not in order for any member to pass over this resolution. If there were no discussion upon this subsection it could be passed by in silence.

Dr. GRAY said that the Conference had not heard the resolutions of the subcommittee yet, and, therefore, did not know what had been done.

Professor GALEOTTI said that all the points which had already been discussed and on which resolutions had been formulated should not be brought before the Conference again.

Dr. ASPLAND said that that had nothing to do with this discussion.

Professor GALEOTTI. Then let us continue the discussion of the other points not considered by the vaccine committee. Really, this question belongs to the bacteriological section. The negative phase is a question of pathology and bacteriology and has nothing to do with epidemiology.

The CHAIRMAN. This is not epidemiology. This refers to the section dealing with measures employed to combat the epidemic, not to the epidemiological section. I rule that we go over this section seriatim and get as much evidence as we can from those who had experience with the different vaccines.

Professor GALEOTTI asked that the negative phase be discussed, not from the epidemiological point of view but from the bacteriological point of view, and that they should discuss whether there could be a negative phase after inoculation. Epidemiological evidence would not bear on these questions; they could only be answered by the result of experiment.

The CHAIRMAN. Your suggestion is not in order. This comes in Section D, treating of measures employed to combat the epidemic. Whatever evidence there is regarding the negative phase can be brought forward.

Professor GALEOTTI said that the Conference might discuss Subsections D 1 b, c, and d, the discussion on Subsections 1 a and 1 e being finished.

Professor SHIBAYAMA asked if anyone had anything to say upon the subjects before the meeting; if not, he suggested that they should be passed over.

DISCUSSION REGARDING THE NEGATIVE PHASE

The CHAIRMAN said that, with regard to the negative phase, the Conference would like to hear from their Russian friends at Harbin who had had so much experience with this question. He was sure they would like to hear the views of Professor Zabolotny and Dr. Haffkine.

Professor ZABOLOTNY said that he had only made a few observations and they could not be regarded as the basis for discussion here.

Dr. HAFFKINE said that the observations he had made were likewise very few and did not contradict former observations made by others. There were only four men who died a fortnight after inoculation. They seemed to be an exception because the negative phase was generally taken to be about ten days; his observations, however, were insufficient to enable him to discuss this question.

Professor ZABOLOTNY said that it was impossible to draw any conclusions from these few observations. It might depend upon the quantity of the dose, or the quality of the vaccine, as to what happened. It could not be decided upon from these data.

Dr. GONZALEZ-FABELA asked the Chairman whether the Conference had not already decided that Subsection D 1 was to be submitted to a subcommittee. He believed that the Conference had only to receive a report of the subcommittee on this point.

The CHAIRMAN. I think there is a little misunderstanding regarding the real meaning of this. The idea of the gentlemen who drew up this programme was to elicit evidence of cases of plague that had taken place among the medical and sanitary staff and others who had been inoculated and as to how many days after inoculation they could safely go to work, and so on. If we have these examples before us we should have something to guide us. It is not entirely a bacteriological matter, but one in which we must also be guided by clinical experience.

Dr. STRONG. I would like to say with regard to this question that I was informed by the chairman of the programme committee that it would not come up this morning. I may have some notes to present upon the negative phase.

Dr. ASPLAND produced the notes made by the chairman of the programme committee from which the programme of the day had been made up.

Dr. FARRAR stated that he had written "D 2," and that the alteration to "D 1" had been made by someone else.

After some informal discussion, Professor GALEOTTI moved that the Conference pass over Subsection D 1 without further discussion and proceed directly to Subsection D 2.

Dr. FARRAR said that Dr. Strong might have something to say about the negative phase at a later date, and he would be extremely sorry if, through any fault of his, valuable evidence in regard to this point was lost.

Dr. STRONG said that he would very much prefer that this matter should not be put off on account of anything that he might have to say.

Dr. ASPLAND seconded Professor Galeotti's proposal. He pointed out that resolutions had been drawn up by the subcommittee after what Professor Galeotti described as a five-and-a-half-hours' fight. If these resolutions came up this morning the fight would last even longer.

The CHAIRMAN said that before putting Professor Galeotti's motion before the Conference he would like to understand clearly whether all five

items in Subsection D 1 were to be discussed by the committee for prophylactic and serum inoculations, for otherwise there would be some misunderstanding about what they ought to do.

Dr. MARTINI said that the committee had not discussed the negative phase. It had not discussed Subsection D 1 c, but he did not think that there was very much to be said upon that point. Subsection D 1 d had been spoken of in many reports; e had been discussed in the bacteriological section and in the committee. He thought, therefore, that only 1 c remained, and that no one had any evidence they wished to give upon this subject.

The CHAIRMAN then put Professor Galeotti's proposition to the meeting, and it was carried. He then called upon Dr. Fang to read a paper upon

INDIVIDUAL PRECAUTIONS TAKEN BY THE MEDICAL STAFF DURING THE RECENT EPIDEMIC AT FUCHIATIEN

By Dr. FANG

The recent epidemic in Fuchiatien has taught us many lessons, but none so important as the value of taking individual precautions among the antiplague staff. Man after man was struck down, even after the use of plague vaccine, and we soon relied almost entirely on the use of a mask for protection. You will see before you over ten varieties of masks from different sources, all having a metallic frame. Each one has its advantage—sometimes in lightness, appearance, comfort, or shape—but it is the opinion of the majority of us who were among plague cases that none can rival the simple pad, made with two layers of gauze inclosing an oblong piece of wool 6 by 4 inches. This pad can be easily made by cutting the usual surgical gauze, 9 inches in width, supplied from the shops, into strips, each measuring 3 to 3½ feet in length. At either end of the gauze two cuts, each measuring 1 foot, are made, thus turning the pad into a three-tail gauze bandage with a thin piece of wool between the layers. The upper tail of one side should be passed round the side of the head above the ear and tied to the other corresponding tail. The lowermost tail should in a similar manner be passed under the ear and tied to the one on the other side, while the middle tail should be passed over the crown of the head, so as to fix the pad and thus prevent it from slipping down the neck, a condition which one sees too often in the case of coolies, policemen, and others. In other words the method of fixing adopted, is a modified jaw bandage. The cost of these home-made masks would be only 2½ cents each. The price compares very favorably with the metal-framed masks. We recommended, therefore, that this mask should be universally adopted for the protection of the respiratory tract when dealing with pneumonic plague.

Its advantages are:

1. Simplicity of construction.
2. Cheapness.
3. Full protection against the entrance of germs,[1] especially if two small pieces of wool be placed within the upper margin, one on either side of the nose. There is then a general pressure exerted all around the entrances to the respiratory tract.
4. Freedom of breathing.
5. Comfort to the wearer, especially in cold weather.
6. Fixity of position for hours at a time.

The value of soaking the wool previously in antiseptics is doubtful, although used during the earlier part of the epidemic. The fact that the lotion froze so easily during the cold weather was a serious objection. Sometimes we used a mixture of equal parts of creosote and carbolic-acid lotion, but when used too liberally it had a tendency to burn the nose and other parts of the face.

Clothing and baths.—It was our rule to use totally different clothing for plague work. This was kept in the disinfecting room. Our procedure was as follows: Before commencing the day's work we changed into our plague uniform, including boots and goloshes, put on a padded mask and a long white coat with a covering for the head. When the day's work was done, the long coat and the shoes and goloshes were sprayed over with carbolic lotion. They were then removed in the first disinfecting room and soaked in a sublimate lotion. We then gargled the throat and entered a second room where the rest of the clothes were removed. We then plunged ourselves into a big wooden tub, containing sublimate lotion (1 in 3,000), and finally washed in plain water, dried, and put on our ordinary clothes. The soiled suit was during the night sterilized with formalin vapor and dried with hot air, so as to be ready for use the next morning. None of our staff used goggles, and no case of infection through the eyes was reported. Glasses and goggles were most uncomfortable in winter because of the water of condensation.

The disinfection of the boots and goloshes appeared to us particularly important, and, besides spraying with carbolic acid, the soles of the goloshes were rubbed on a mat soaked with a solution of carbolic acid or on a tray containing powdered lime.

These precautions might appear to some unnecessary, but we had to avoid infecting others during our routine work. The wearing of a mask, such as the one recommended by us, was as important to coolies, the sanitary police, attendants at hospitals,

[1] See footnote Part II, Interim Report, page 394.

and others engaged in antiplague work as to the medical staff. We felt sure that the enormous mortality among the stretcher bearers, hospital attendants, and native physicians was due to their not wearing a proper well-fitting mask. We believed that for them the wearing of a mask was even more important because so many refused the prophylactic inoculation.

DISCUSSION

Dr. STRONG asked Dr. Fang whether his staff had examined the tonsils and throats of plague patients clinically without wearing glasses.

Dr. FANG said that he had worn no glasses.

Dr. STRONG. You examined the throats and tonsils of patients without wearing glasses?

Dr. FANG repeated that he had worn no glasses.

Professor KITASATO said that the wearing of spectacles or goggles was a very important matter. The Japanese had learned this from the experience of one of their doctors who was examining the tonsils of a plague-infected patient and caught the infection through the conjunctiva because the patient coughed at him. The infection went down the lachrymal canals and the doctor died with tonsillar and septicæmic plague. For this reason it was most important to wear goggles.

The CHAIRMAN then called upon Dr. Gray to read a paper on quarantine.

Dr. GRAY replied that his paper would be rather out of order if he read it, and that he had not intended to do so to-day. It dealt more with measures to be taken than measures that had been taken, and therefore he would not read it at this session.

The CHAIRMAN. The meeting is now open for the discussion of subsection d (2), *The establishment of hospitals for suspect cases.*

Professor ZABOLOTNY said that he had seen many plague hospitals in which the measures were very defective for receiving the sputum of the patients and rendering it less dangerous for the attendants. This question was very important, and proper receptacles should be provided for sputum. He thought it was a good thing that the bed should be covered with gauze around the patient's head in the same way as when mosquito nets were used. The gauze would catch the drops of sputum. Gotschlich had done this at Alexandria and found it very effective. It was also very important to have mats, soaked with sublimate or carbolic acid, upon the floor for cleaning the feet, so that everyone

going out of the room would disinfect his shoes immediately and not carry plague germs all over the building upon his boots.

Dr. CHRISTIE said that they would expect some guidance upon the construction of segregation camps for quarantine work, hospitals for suspect cases, and also plague hospitals. There were many very important questions, such as how many persons should be put into one room in a segregation camp. There was considerable disagreement even among medical men in Manchuria on this point, when the question of the construction of camps came before them. Some thought that each man should have a separate room. Some said that five men or even twenty-five might share one room. Then there was also the very important question whether suspect hospitals should be erected near the railway station or not, and whether the suspect hospital should be placed alongside the plague hospital. It was very important that suspect cases, when proved to be plague, should be as near the plague hospital as possible. How could they be kept separated and yet at a convenient distance? Then there was the question of the site of the plague hospital. How far should it be from the site of a city like Mukden? Should it be inside the mud wall, and if not, how many miles outside? Several plans had been proposed for segregation camps. One that had been prepared for Mukden he would be very pleased to show to anyone at the Conference who desired to see it. There was also a plan for a plague hospital which seemed to be a simple one and upon economical lines. There was the question of how much cubic space ought to be allowed for each patient, and also the important question of how many pneumonic cases ought to be placed in one ward. He merely mentioned these questions as points upon which the Conference ought to give some assistance.

Dr. FARRAR said that, with regard to hospitals, it was obviously impossible to have them in readiness and completely equipped for such a large epidemic as that which had suddenly occurred. It might, however, be found possible to have the nucleus of a hospital organization—that was to say, to have an administrative building and a certain amount of permanent accommodation ready. Foundations could also be kept in readiness against the time when plague occurred. In a climate like that of Manchuria when the ground was frozen hard it was extremely difficult to erect a plague hospital at short notice, but if stone plinths were ready for the foundations, corrugated iron buildings, lined with wood, could be run up at short notice in less than twenty-four hours. A good system was also used by the British Army and

might be found of service in Manchuria. This was the use of papier-mâché, made in strips, which could be hooked together. They were quite easy to run up.

Dr. Aspland said that he thought that it was the opinion of the majority of the Delegates that they wanted to get through the business part of the work. Both of the last two speeches were entirely out of order. They did not relate to what was done during the past epidemic but what should be done in future epidemics. What was to be done in future would come up when the resolutions were discussed.

Dr. Christie said that he had spoken entirely upon the past epidemic.

Dr. Strong said that he thought that experimental evidence brought forward at this Conference showed that the only safe system of hospital construction for pneumonic-plague cases and suspects was the cubicle or box system in which each patient was entirely isolated by a partition.

Professor Zabolotny said that he thought that the question of hospital construction ought to be discussed in a small subcommittee meeting, where plans for a model hospital could be drawn up as one of the recommendations. There were a great many important questions which had to be considered also, but could hardly be profitably discussed at a full session, such as the questions of beds, lighting, receptacles for sputum, etc., which should be carefully considered.

The Chairman said that it would be better for him, perhaps, to guide the Conference as to the way in which discussions ought to take place. They wanted to discuss measures employed to combat the past epidemic. They would be glad to hear from anyone who had information to give as to what had been done.

Dr. Chabaneix produced a plan of a quarantine and segregation camp which had been erected and used during the past epidemic. He said that it was intended to hold 500 third-class passengers. The buildings were about 520 feet long and 30 feet broad. It was entirely surrounded by a fence, and contained a certain number of blocks. Each block was 300 feet long, and contained 20 rooms, each for five persons. A room consisted of three parts. There was a small yard in front and a closet behind. If the camp were intended to hold 500 people for five days, about 100 could enter daily. On arrival they would be taken into a waiting room and their luggage would be sent to a storeroom and registered and a receipt delivered to each arrival. Then they passed into the bathrooms. There were sterilizing rooms, fumigation rooms, laundry, storeroom, doctors' and as-

sistants' houses, kitchen, houses for coolies, refuse burner, house for the sanitary police, etc. When a man entered his room he was locked up, was examined daily, and his temperature was taken by the doctor and assistants in charge.

Dr. ASPLAND said that on the subject of quarantine stations he would like to speak of what they considered to be the advantages of railway wagons in relation to units of quarantine and segregation camps. As they probably knew, at Fuchiatien railway wagons were used for this purpose by Russians and Chinese. About 100 railway wagons were used, and it was calculated that, if pressed for room, each wagon could hold about twenty people. In a few instances there were twenty persons in one wagon, but a great many had only five and some less than that. The advantages of these wagons were that at any point upon a railway line they could be procured easily; especially was this so during the last epidemic when quantities of railway rolling stock were practically at a standstill. As one looked back now it seemed impossible to imagine why the ready use of these wagons was overlooked at places in Manchuria and long periods of time were lost in putting up permanent buildings. Each railway wagon was fitted with bunks at either end. There was cross ventilation from the two side doors. There were four small windows, one at each corner, and there was a stove in the middle, so that the wagons were thoroughly ventilated and heated. The coolies found them more comfortable than their own hovels, dugouts, and inns. Another advantage was the ease with which they could be disinfected. At the daily routine examination, as soon as the men were removed to the suspect or plague hospitals, it took a very short time to turn out the contacts and, with a forced air spray, to disinfect the whole of the car with perchloride or carbolic acid. Then, dealing with these wagons as units, it was easy to shift them from one place to another, so that in the event of one wagon becoming very virulently infected by a large number of cases it could be entirely removed. He thought that these were some of the items that had impressed themselves upon those who worked with the wagons at Fuchiatien. More particularly, there was the fact that railway wagons, in centers near the railway, could be so easily procured that in the course of two or three days a quarantine station could be prepared which would hold 2,000 to 3,000 persons. There were 4,187 contacts in the Fuchiatien wagons besides 300 coolies and police on duty, and the death rate was only 5.6 per cent as compared with the statistics for Mukden, where there were 1,672 persons in the quarantine camp, and 181

deaths or 10.8 per cent. This was very satisfactory and showed that in Mukden, where houses were used, they had practically double the death rate observed in the wagons. This, it seemed to him, might be accounted for by the fact that there was probably a larger number of persons in each room in Mukden, and as a result of this the infection was intensified.

Dr. CHABANEIX said that he quite agreed with Dr. Aspland and the Russian doctors about the question of the convenience of placing suspects in railway wagons, but these wagons were not always available in large numbers, and it was a very expensive method of accommodation. Where a large number of contacts had to be isolated that was a question that had to be considered.

Dr. FARRAR. Were these railway wagons hired or loaned?

Dr. ASPLAND. I believe that they were hired from the Russian railway at the rate of 3 roubles [$1.80 United States currency] per day. I did not touch upon the question of expense, but only upon that of expediency. Until a permanent quarantine station is established, in spite of the expense, this is a ready means of forming a temporary one.

Professor ZABOLOTNY asked Dr. Aspland whether it was not a fact that the sum he had mentioned was for heating the cars, and other general expenses. He believed that a good many wagons were put at the disposal of the Chinese authorities free of charge by the Russian Government.

Dr. GRAY said that the information given to him was that the wagons were leased at a rental of 3 roubles daily each car.

Professor ZABOLOTNY repeated that he understood that a number of wagons were loaned free.

Dr. ASPLAND said that he knew nothing about that. He had as his authority the antiplague bureau. The fuel certainly came under the expenses of the quarantine station, because the manager had to buy all the wood just as he bought the provisions. The fuel, therefore, certainly came under the expenses of the quarantine station. As to the hire of the cars, he was given to understand that 3 roubles per day per car was paid. Whether a certain number were loaned free he could not say. He ought to mention, perhaps, that in this quarantine station the building, which was used as the plague hospital on one side and the suspect hospital on the other side, the big administration building, and that used for disinfection, four large buildings altogether, were kindly loaned to them by the Russian authorities and they had only to be put into repair.

Professor ZABOLOTNY said that railway cars for isolation pur-

poses had some advantages, inasmuch as they could be quickly fitted up, were easily movable, and easily disinfected. But they also had some drawbacks. Each of them contained ten to twenty persons, and in his opinion that could not compare with the best method, which in his opinion was the cubicle system which had already been recommended by Dr. Strong. This system could not be installed or arranged in the cars. Compared with the ordinary isolation rooms, or night refuges, or Chinese houses on the spot, which contained more people, cars were preferable, but one could not say they were ideal. Some preventible contagion took place in the cars.

Dr. HAFFKINE said that quarantine was practically useless unless those who entered the stations were put into proper baths and their clothes were properly disinfected. The temperature of the people should be taken at least twice a day. In cars or wagons it might be somewhat easier to prevent infection than in ordinary houses, but even in cars the temperature of the inmates should also be taken twice a day. They knew that unfortunately in many stations, such as Fuchiatien, there were no proper arrangements for giving the patients baths or properly disinfecting them.

Dr. CHRISTIE said that he did not think that as a permanency, cars would be at all satisfactory. They were expensive and too large, and there was great inconvenience in cooking in them, and so on. Accommodation for coolies, bathing, disinfecting, etc., was very difficult indeed to carry out in these cars, and he thought the best system was the cubicle system recommended by Dr. Strong. He produced for inspection a very simple plan for a segregation camp which had been erected in Mukden. It was fairly complete, but not very extensive. It was built of galvanized iron over a framework of wood, and contained accommodation for first-, second-, and third-class patients, as well as rooms for doctors, a storeroom, room for attendants, and a baggage room where baggage could be taken after disinfection. There were doors leading into the various classes, and the rooms contained two to six beds each, but not more. There was a little place for open air in front of each room and a privy at the back. Of course the proportionate accommodation for third-class passengers was insufficient, but the hospital was only built to accommodate 240 persons altogether.

Dr. ASPLAND said that he would like to ask Dr. Strong some questions about the box system he advocated. He had recommended the box system for diagnosed plague cases the preceding

afternoon. Did he also mean that he wished this system to be used for contacts as well? Dr. Christie had stated that in the quarantine camp constructed in Mukden six persons were put into one room.

Dr. STRONG said that he thought that the box system of isolation was the best for contacts and patients. In the plague hospital in Mukden, although precautions had been taken, patients had occasionally been admitted who were not suffering from plague. They remained in the ward for several days and were exposed to plague infection during that time. He thought that occasionally, even with great care, a patient who had not contracted plague might be admitted to the plague hospital, and, if the cubicle or box system were adopted, his life might be spared. He thought that that was the best system, both for the contacts, as well as for plague cases, for one contact who developed plague might infect the other individual in the car with him.

Dr. ASPLAND. And also for a segregation camp?

Dr. STRONG said that the plans for a segregation camp would be different. He thought that the cubicle system of isolation was the ideal method for definite cases or suspected cases. The details of construction should be considered by a committee on hospitals. He would like to second Professor Zabolotny's proposal that there should be a special committee to go into the question of hospital construction.

Dr. GRAY said that in contact and segregation buildings one of the most important sections of the staff was that of the guards or policemen. He had heard of several specific cases in which people had escaped from the hospital. In Dr. Christie's plan no provision was made for guards. During the small outbreak of plague that occurred in Peking, one man who had been in the quarantine station for three or four days escaped and went by train to Tungchow, where he infected his village. Eight deaths followed this man's arrival at his village and infection spread to one or two other quarters from this man. Therefore, a guard for these hospitals and camps was absolutely necessary.

Dr. CHRISTIE stated that at Mukden there was a guard-house at the station already, so that it had not been necessary to include provision for guards in his plan.

Dr. PETRIE asked Dr. Aspland what was done in these railway wagons when a case of plague broke out in one of them. Suppose that there were twenty persons in a wagon in which a case occurred. Were the 19 persons isolated in another wagon, or

were they divided into two lots and put into separate wagons, or what?

Dr. ASPLAND stated that at the routine daily examination they were careful to look for rapid pulses. After the beginning they did not rely upon temperatures, because a patient might be in the stage described by Professor Zabolotny, when the fever had fallen and he was in a more infectious condition, just before his cough commenced. Therefore, they relied exclusively upon the pulse, which kept rapid, more or less, all the way through the disease. If a man was found with a rapid pulse, he was at once removed to the suspect hospital, and all the people in that wagon were put into another wagon. The infected wagon was then fumigated with formalin, or sulphur, and closed for twenty-four hours. The people, who had been in it, and the wagon itself were thoroughly disinfected.

Dr. HILL asked what time of the day the persons in the wagons were examined. If they were examined in the evening and no symptoms were found, the chances of secondary cases arising and becoming infective by the morning were practically nil. Therefore he thought that an evening inspection was best. He also desired to ask whether any distinction was made between a contact station and a quarantine station, between those who had actually been in contact with plague cases and those who had come from an infected area.

Dr. CHRISTIE said that the Conference was getting mixed up between contact stations and segregation camps. In the segregation camps all the inmates were supposed to be healthy people. For that reason, in the plan he had circulated, as many as six persons were allowed in one room. They were all supposed to be healthy. It was economical to have them in small rooms, because, although the first cost might be greater, if a case of plague broke out all the persons in the room had to be cleared out and the room had to be disinfected and for several days it could not be used. Therefore, with smaller rooms the expense, when a plague case occurred, was not so great.

Professor KITASATO said that during the morning he had observed persons taking part in discussions upon one subject three or four times. The rules drawn up a few days previously ought to be strictly adhered to.

Dr. ASPLAND, replying to Dr. Hill, said that with regard to the point made by him about taking temperatures in the evenings, they commenced work about 11 a. m. each day. On an average they had 1,500 to 1,600 persons to see each day, so that it was

generally after 5 p. m. before their work was finished. Thus they had to make one examination do for the whole day. At Fuchiatien persons put into the contact wagons were those who had been removed from houses, where either dead or sick plague cases were found in the four sections into which the town was divided.

Discussion regarding Subsection D 2 f:

NOTIFICATION OF SICK PERSONS AND CORPSES FOUND IN HOUSES OR STREETS AND OF COFFINS SOLD—HOUSE-TO-HOUSE VISITATION

The CHAIRMAN said that a great deal of attention had been devoted during the epidemic to the sale of coffins. Those who had had experience should enlighten the Conference on this matter.

Dr. CHABANEIX stated that the notification of the sale of coffins had been enforced at Tientsin and was found to be a good measure. Coffins were sometimes brought into the town from outside, but he considered notification of the sale of coffins a good measure for discovering plague cases.

The CHAIRMAN said that the Chinese had enforced notification of the sick and also of the sale of coffins. He was sure that the Conference would like to hear what had been done in this respect by their Russian and Japanese colleagues.

Professor KITASATO said that in Japan it was not necessary to adopt the system of notification of the sale of coffins, as there were strict regulations that all deaths must be reported immediately to the authorities; thus all deaths were discovered.

Professor ZABOLOTNY said that in Russia it was likewise unnecessary to exercise supervision over the sale of coffins, because all deaths had to be declared. He did not think this method was of much practical use even in China, because many corpses were thrown into the fields or on to the streets. By counting the coffins sold they would not get an accurate idea of the number of deaths.

The CHAIRMAN. Is there no more discussion upon this point? If not, I should like to make a remark. In Peking all deaths had to be reported; this was the first time, I believe, of the occurrence of such a measure in Chinese history. Let us hope that it will be continued, taken up in all cities, and lead to an accurate record of deaths.

Dr. CHABANEIX said that the registration of deaths had been enforced in Tientsin since 1900 by the police and sanitary department.

Discussion regarding Subsection D 2 g:

MEANS OF DISINFECTION

The CHAIRMAN said that the question of burning houses was one that was important, because, if it were unnecessary, it would save the people much loss and the Government considerable compensation.

Dr. PETRIE said that he understood that a great deal of disinfection work had been done. He would like to know upon what grounds this disinfection was carried out. Was it upon the assumption that houses were infective after plague corpses or cases had been removed? The same question likewise applied to burning. Was that carried out on the assumption that houses remained infective after cases had been removed? Was there any evidence, either epidemiological or experimental, that these houses remained infective?

Dr. ASPLAND said that, if he might speak for Fuchiatien, house disinfection was done because they did not know what else to do. None of the staff had had anything to do with pneumonic plague before and so they treated it like any other infectious disease. If the members of the Conference had seen the majority of the houses that were burnt, they would probably have stated that they considered that they ought to be burnt whether they were infective or not and that a public service was being done by burning them.

Dr. CHRISTIE said that there were two or three badly infected houses in Mukden, which were well built and valuable. It was a very difficult question to decide what ought to be done with them. However, they thought it best to err on the right side and so they burnt them. But it was a very important question. Really it seemed to be a bacteriological question more than an epidemiological one; for instance, how long a house was infective.

Dr. HILL said that he would like to ask also whether there were any statistics to show that overcrowding tended to a greater incidence of the disease among contacts, because, if so, it seemed to him that lack of ventilation was a sufficient consideration for burning houses because they constituted dangerous centers in the epidemic, apart from the question whether they were infective.

Professor KITASATO said that he had not had any experience of the length of time infection lasted in houses because the Japanese had very strict regulations that houses must be disinfected before the inhabitants returned to them after a case of plague. They were not allowed to return to their houses until

two days after disinfection. Therefore, the Japanese had no experience of the duration of infectivity in houses after death. He might speak of one experiment in Japan which had been frequently repeated, namely, guinea pigs were put into a house where plague rats had died and left there for two or three days. Sometimes, especially in the summer and autumn, they found that these guinea pigs had become infected with plague by fleas. This, of course, was in connection with bubonic plague.

Dr. PETRIE said that, as an illustration of the futility of measures taken at the beginning of the epidemic, he might mention an instance where measures taken were subsequently shown to have been futile because there was no definite, scientific evidence on the subject at the time. At the beginning of the bubonic outbreak in India, tremendous sums of money were spent upon disinfecting houses. The Indian Plague Commission experimented by disinfecting some of these houses and also by fumigating them with sulphur. Disinfecting solutions were thrown on the floor, which was so saturated that pools of the fluid could be seen. Guinea pigs were then put into the disinfected houses and allowed to stay there over night, when they were removed. It was found that these guinea pigs died of plague. The methods of disinfection used were proved to be quite ineffectual, and it appeared that all the money spent in this way had been spent uselessly.

Dr. STRONG. That also was in connection with bubonic plague.

Dr. PETRIE. I gave it merely as an illustration of how useless methods may be when not founded on scientific observation.

Dr. STRONG. We do have definite foci of infection from the sputum, in cases of pneumonic plague in houses. In bubonic plague the flea is the infecting agent, therefore, disinfection, ineffective in bubonic plague, might be partially effective at any rate in pneumonic plague.

Professor ZABOLOTNY stated that it had been observed in Russia that people had become infected after returning to houses that had been disinfected, but he could not state whether they got the infection from the houses or elsewhere.

Dr. HAFFKINE said that there were many points of difficulty in regard to the disinfection of Chinese houses. This was especially the case in the Rue de Russie at Harbin where a house had been disinfected three times in six weeks and cases of infection were still found. This house was burnt.

Dr. CHABANEIX said that in Shanhaikuan they adopted the method of burning houses. There were 16 cases of plague there and all the infected houses were burnt. No more cases occurred after that. In Tientsin disinfection was done with chemicals.

Not a single case of plague occurred in houses that had been disinfected, but this statement was not very conclusive. It would be necessary to wait until the summer or next winter to see if plague infection remained in the houses.

Dr. ASPLAND said that, with regard to this question, he might mention the case of a large house which formed part of the refuge to which discharged contacts from the quarantine station were sent. Previously it had been used as a refuge and also it was the old quarantine station, from whence plague patients were daily removed. This was a house with nothing but mud walls, floors, *k'angs*, etc. It was so dark that it took some seconds to discern the far end when one entered it. When all these contacts were removed this house was disinfected. He could not say it was thoroughly done. Later about 150 contacts were put into this room and remained there for six weeks and not one of them developed plague. The general impression at Fuchiatien was that, after disinfecting houses, there was no evidence that persons subsequently became infected from the house.

Dr. GRAY asked if there was any evidence before the Conference of people who were plague free who had gone into undisinfected houses and there caught plague. This was a very important point before the Conference as also was the question of burning houses, because, connected with it, was the concealment of death. On a case breaking out in a man's house, if the man knew that he and his wife and family would be taken to segregation quarters and that his house would be burnt during his absence, it gave him cause, and he thought it would give anyone else cause, to endeavor to conceal death if such a ruthless course were to be pursued. There was another point; whether it has been proved that the burning of houses was a practical measure, for in a great many of these houses what happened was that the wooden beams took fire, the roof fell in, and the walls remained practically unscorched, and the occupier found that his house had been needlessly destroyed without any compensating advantage. It would be interesting, therefore, to learn if anyone knew of a single case in which an uninfected man had gone into a house not disinfected and there contracted plague.

Dr. ANDREW said that he quite agreed with Dr. Gray that this was a most important question. So far as he could gather from the discussions of the Conference, there were absolutely no grounds upon which to recommend either the burning or the disinfection of houses upon a large scale. One point the Conference seemed to have decided was that the plague bacillus

could not live, once it was dried. He thought, therefore, it would be much more practical and effectual to try to heat the interior of a house rather than waste large sums of money upon disinfectants, when they did not know whether they were doing any good or not. He thought they ought to act upon the scientific evidence that, once dried, the plague bacillus was harmless, so it seemed to him much more practical to devise a means of drying a house.

Dr. STRONG asked if formalin disinfection had been tried, and whether it was practicable in Chinese houses.

The CHAIRMAN said it had been mostly used in the disinfecting stations; in Chinese houses it was of very little use.

Dr. STRONG asked if it were not really practicable in Chinese houses.

The CHAIRMAN said that it was not. There were too many holes and the windows were made of paper.

Dr. ASPLAND said that what he had stated just previously seemed to have been taken as evidence of the efficacy of disinfectants. He had not meant it in that way, but simply to show that, however much one disinfected with carbolic acid, inspection would show the impossibility of disinfecting Chinese houses in an adequate manner.

Dr. CHABANEIX said that, with regard to formalin disinfection, the method he had used had been to place in a dish a block of potassium permanganate. This block was acted upon by the formalin, and by this interaction formaldehyde gas was produced. Knowing the capacity of a room, they could estimate the exact amount required for its disinfection.

The CHAIRMAN said that in Fuchiatien the Chinese Government used sulphur chiefly for the disinfection of houses. He was sure that the members of the Conference would like to hear what had been done in other places by their Russian and Japanese colleagues.

Dr. STRONG asked if there was no evidence at all in regard to the use of formalin disinfection in this epidemic in large towns. It had been used extensively in diphtheria epidemics.

Professor KITASATO said that the Japanese had worked chiefly with carbolic acid and sublimate and occasionally with lysol. It was found that sulphur and formalin fumigation were of no value in Japanese houses. They had sprayed the places where sputum was found with carbolic acid or sublimate.

Professor ZABOLOTNY said that they also had used sublimate and carbolic acid. In Russia they used sulphur fumigation against insects and not for disinfection.

Dr. HAFFKINE said that in Harbin according to the recommendation of Prof. Zabolotny, they had used a hot solution of carbolic acid and green soap and this mode of disinfection was found easy and effective.

The CHAIRMAN asked whether anyone had any practical acquaintance with such new preparations as phenoid, izal, and pesterine.

Dr. ANDREW said that this being such an important question he thought that the Delegates to this Conference while in Mukden should take the opportunity of visiting and actually inspecting a typical Chinese house in the slums, as it might be useful later on when they came to the question of making recommendations.

Dr. STRONG said that he thought many of the Delegates had already done so.

Discussion regarding Subsection D 2 h:

REMOVAL AND DISPOSAL OF PLAGUE CORPSES

Professor KITASATO said that all corpses of plague-pneumonia patients should be burnt. This should be made compulsory.

Dr. STRONG said that it seemed to him that the methods of removal of corpses, as were shown by the photographs on view, were not above reproach and this question should be considered in drawing up the resolutions.

Dr. FARRAR said that statistics as to the mortality among a burial corps would be interesting. They differed in different places. In Changchun, he was informed, 50 per cent of the burial coolies had died of plague.

The CHAIRMAN. The figures were 31 out of 91.

Dr. ASPLAND. Before you can settle such a question as that you have to consider where your burial coolies are housed. It seemed to us that the men who carted bodies from the plague hospital to the cremation areas were not infected by doing so, but if we allowed them to wander where they liked and to go back to the inns they would probably become infected.

The CHAIRMAN. At Changchun these 31 men were housed in a separate compound next to the cemetery.

Dr. HILL said that a report he had received from Chefoo stated that none of the burial corps had died.

Dr. CHRISTIE said that of 150 of the burial corps at Mukden not one died.

Dr. CHABANEIX stated that in Tientsin there were no deaths among the coffin carriers.

The CHAIRMAN asked what the experience of his Russian colleagues was.

Professor Zabolotny stated that at Harbin among the detachment that had to bring corpses to the hospital and among the burial corps not a single death occurred.

Discussion regarding Subsection D 2 j:

PRECAUTIONARY MEASURES FOR THOSE ATTENDING THE SICK

Dr. Farrar said that in connection with the question of masks in Chefoo it was found, at first, that it was impossible to persuade coolies or anyone else to wear them. Afterward a temple seal was stamped upon them, and the people became reconciled to wearing masks as a sort of amulet.

The Chairman said that he would like to have some definite information upon the comparative value of the masks before them.

Dr. Petrie asked Dr. Broquet whether he wore an ordinary cotton-wool pad under his mica mask and whether it could be disinfected easily.

Dr. Broquet stated that it was not necessary to put a cotton-wool pad beneath.

The Chairman said that it might be interesting to have some information in regard to the use of antiseptics with masks.

Dr. Strong said that he thought that wet antiseptics were unnecessary.

Professor Zabolotny said that he thought that masks should be thrown away after use. He did not think that any disinfectant should be used, as the rôle of the mask was a purely mechanical one.

Dr. Broquet said that a mask should be constructed to cover the entire face, including the mouth, nose, and eyes. If a mask of cotton wool were used over the mouth, the conjunctiva might be infected. A good mask must cover the whole of the face. The mask he had shown was copied from those used by doctors in the epidemic of the 14th century as shown in old books, but in the case of these old prints two holes were left for the eyes, as the possibility of infection through the conjunctiva was apparently not realized. To sterilize his mask it had only to be thrown into boiling water. He had used this type of mask in Mukden. He had sterilized it under conditions which would have broken it, if it had not been strongly made. It was also very advantageous to be able to work with a large clear opening before the eyes. He did not consider that the other masks, which covered only the nose and mouth, were sufficient.

Dr. Aspland said that the practical side of masks had to be considered. He desired to ask Dr. Broquet whether he had

worn his mask for three or four hours at a time at a temperature of about 20° C. below zero. He was inclined to think that Dr. Broquet's mask was a very good one for a plague hospital where the temperature was moderately warm. In their sanitary work outside, they found at Fuchiatien that, if they wore goggles, the moisture from the heat of the face condensed on the glass and it then became impossible to see. One's eyelashes and eyebrows rapidly became covered with small icicles. He thought that for the climate of Manchuria something must be suggested which was practicable.

Dr. BROQUET replied that it was only necessary to wear the mask when near a patient; consequently it would not be worn for two or three hours.

Dr. STRONG asked Dr. Broquet whether he could wear his mask for two hours at a time with comfort or whether it would not be suffocating. That was a very important point to consider; it seemed to him to be an excellent mask if the water did not condense on the mica. But he thought that unless it could be worn comfortably for, say, two hours at a time it was not a practicable mask. It was sometimes necessary to sit in the plague wards for an hour or two at a time if one were giving intravenous injections.

Dr. BROQUET said that he thought that his mask could be worn for two or three hours very much more easily than any cotton mask. He did not claim that it was an ideal mask, but it would be interesting to try a mask made on these lines.

The Conference then adjourned.

SESSION XV, APRIL 20

PROGRAMME ARRANGED FOR THE DAY

I

D. Measures Employed to Combat the Epidemic.
3. Measures to be taken to prevent a widespread diffusion of infection.
a. Sanitary cordon to prevent ingress of possibly infected persons or goods.
b. Railway quarantine of passengers and goods.
c. River quarantine of passengers and goods.
d. Sea quarantine of passengers and goods.
e. Control of coolie migration.

II

Rules of procedure for the second part of the Conference.
Election of committees.

SUMMARY OF PROCEEDINGS OF THE SESSION

1. Preliminary business.
2. Quarantine necessary at Shanghai against northern ports infected with pneumonic plague.
3. Discussion regarding quarantine.
4. Relation of plague infection to rats, foodstuffs, skins, furs, etc.
5. Discussion on railway, sea, and river quarantine.
6. Discussion and adoption of rules of procedure for the second part of the Conference.
7. Election of committees.

Dr. Wu took the chair at 10 a. m.

The Secretary. The following telegram was received yesterday from Mr. Nakamura, president of the South Manchuria Railway Company:

"Delegates International Plague Conference, Mukden: I beg to acknowledge with great satisfaction receipt of courteous message from the Delegates of International Plague Conference and their companions for what little I contributed to make their recent excursion to Dairen enjoyable, and present them all with my best wishes.

"Nakamura."

The minutes of Session XIV were accepted.

The Chairman then called upon Dr. Stanley to read a paper upon *Quarantine measures at Shanghai against northern ports infected with pneumonic plague.*

QUARANTINE MEASURES AT SHANGHAI AGAINST NORTHERN PORTS INFECTED WITH PNEUMONIC PLAGUE

By Dr. STANLEY

Early in the present year, ships from the northern ports which were plague infected or in close communication with the plague-infected *hinterland* were required to undergo medical inspection and remain under surveillance at the quarantine station for the unexpired period of seven days after leaving the last plague-infected port.

After being admitted to pratique, measures were taken against rats, namely, the ships were not allowed to lie alongside wharves, but were required to anchor in the stream and to discharge and ship cargo by daylight only by means of cargo boats, using rat guards on the lines. Ships provided with certificates of recent fumigation were, however, allowed alongside and to work cargo during daylight; at night all cargo ports and hatchways were required to be closed and gangway planks withdrawn, ropes between the vessel and the wharf or pontoon to have rat guards, and floating fenders to be used to keep the ship at least 4 feet clear of the wharf, fender ropes being made fast to the wharf and not to the vessel.

Subsequently, in order to interfere as little as possible with the transport of merchandise, the period of detention at Shanghai during the unexpired incubation period of possible cases of plague was waived where first-class passengers only were carried who had proper certificates that they had been kept under medical observation for five days at Dairen, Tientsin, and Chefoo respectively before embarkation. Through passengers from Europe via Dairen were not required to be detained anywhere if provided with the certificate of the sanitary authority of that port that they had come directly through, by unbroken journey, from Europe.

Later, night working of cargo was permitted after repeated fumigation with sulphur had shown the vessel to be practically free from rats; and later still, fumigation once a month was considered sufficient.

As regards merchandise, the only Manchurian produce affected was furs, skins, and hair from plague-infected parts, which were permitted entry into Shanghai if accompanied by a certificate of disinfection, giving marks of identification, from the medical officer of the port of shipment. Coffins containing corpses were not permitted entry.

The measures taken, therefore, were such as would prevent

the entry of pneumonic-plague cases or of persons in the incubation period and the landing of plague-infected rats.

When the measures against rats were imposed it was not known with certainty that rats were not infected in the northern ports. I take it that the evidence of noninfection of rats, which has been laid before the Conference, warrants the conclusion that rats are probably not infected, but that the infection of rats can not be absolutely excluded.

In conclusion, I beg to submit the following considerations:

1. In pneumonic plague, without rat infection, quarantine measures should only be taken against persons, not against merchandise.

2. In bubonic plague, preventive measures should be chiefly directed against the rat.

3. The plague bacillus has no existence, from the point of view of practical prevention, outside the living body of man or animals.

DISCUSSION

The CHAIRMAN. The question is now open for discussion.

Dr. ANDREW. May I ask Dr. Stanley, during the time that the plague was present here in Manchuria, what his object was in putting restrictions upon vessels coming from Chinwangtao to Shanghai, seeing that during the whole epidemic Chinwangtao was free from plague. Not a single case occurred there, but still restrictions were put upon vessels coming from that place.

Dr. STANLEY. In reply to Dr. Andrew's question, restrictions were placed upon ships from Chinwangtao because it was considered that it had close communication with a plague-infected *hinterland.*

Dr. ANDREW. I want to say one or two words about quarantine regulations that existed during the past epidemic. I think that in many cases these regulations were framed with quite an erroneous idea as to how plague infection was spread. To give you one example: The port of Chefoo, which is about eighteen hours from Chinwangtao, was, as you know, badly infected during the recent plague epidemic, while at Chinwangtao we did not have a single case of plague. Ships coming from Chefoo to Chinwangtao after medical inspection were allowed immediate pratique—that is to say, that the incubation period of the disease was not nearly covered—whereas ships going from Chinwangtao to Chefoo—i. e., ships going from a plague-free port to a plague-infected port—were not allowed pratique until they had

done seven days' quarantine. This is one example of the quarantine regulations in China. If you probe further you will probably find others equally as bad.

Dr. PETRIE asked for more information with regard to quarantine, especially with regard to goods. He wished to know what goods were regarded as suspected.

Dr. ANDREW. To quote one example: Quarantine was enforced against the landing of fruit from south China, where there was no infection at all. I remember one instance in which a ship load of beautiful fresh oranges arrived at Chinwangtao and the railway company refused to have anything to do with them, so that the oranges spoiled and the owner incurred a very serious loss.

Dr. PETRIE further inquired what was done in regard to the disinfection of letters and mail bags.

Dr. CHRISTIE. Instructions were received here from Peking that all mail bags were to be disinfected before being forwarded, so we took action, although we felt it would be quite useless. The bags were disinfected with formalin vapor. I considered it useless but it had to be done, as we had received instructions from Peking to do it. We only disinfected the bags, not the letters.

Dr. GRAY. I think this is the place to put on record the fact that, throughout the recent epidemic, there was no control of coolie migration—that is, no proper control of coolie migration as far as junks were concerned. Several instances occurred of coolies who found that the excellent sanitary arrangements at Dairen interfered with their crossing by steamer, and so they proceeded along the coast and hired junks and sailed across to Shantung. In one specific instance, two men, who landed upon the beach, were in a very sick condition and died shortly afterward. I think, in future epidemics, note should be taken of this: The requirements of sea quarantine are not complete unless they take into account the junk traffic between different ports.

Dr. ANDREW said that junk quarantine had been enforced during this epidemic. It was instituted at Chinwangtao, where they had a regular system of quarantine patrol. No junk was allowed to enter without medical inspection and seven days' quarantine.

Dr. CHABANEIX said that the same applied to Peitang and Tangku.

Professor KITASATO. We allowed mail bags and letters to enter Japan as well as beans from Manchuria. There was no infection in Japan from these sources.

Dr. ASPLAND, at the Chairman's request, read the following extract from a paper by Dr. Daly, of Newchwang:

RELATION OF PLAGUE INFECTION TO RATS, FOODSTUFFS, SKINS, FURS, ETC.

Rats.—Rats are already reported to have become infected in several districts, and there is reason to fear that should this infection spread, bubonic plague will sooner or later make its appearance. Accordingly, it would be well that a concerted plan of action be drawn up for the destruction of these pests. The system of offering rewards for rats leads to the establishment of breeding farms. It would be better to form rat-killing gangs in each center.

Articles prohibited in plague time.—Foodstuffs: Fruits and vegetables are for some reason or other almost invariably included in lists of prohibited goods. Can these possibly carry infection? If not, they should be struck out, as it is a great mistake unnecessarily to interfere with food supplies.

Animal food: Cattle, pigs, and other animals are liable to become infected, and some medical men assert that the flesh of such infected animals may convey plague to those who partake of it. Can the Conference state how long the bacilli live in a carcass? Is there any danger of contracting plague from the cooked flesh of infected animals? If so, the sale of meat ought to be carefully regulated.

Skins, furs, animal and human hair: A large and valuable trade is carried on in these commodities which is threatened by present restrictions. For instance, Austria has refused to admit 30,000 kilos of Chinese hair. Can bacilli live on these goods when exposed to the air? Pigs' bristles are brought to Newchwang for treatment before export. I have never known a case of plague to be contracted from handling or sorting these goods by the workmen so engaged, even in the present epidemic.

Plague corpses.—How long are these infective? It is of some importance to determine this, as sanitary authorities are constantly called upon to permit the transportation of bodies to the ancestral home. In connection with this it may be interesting to state that, in the epidemic of 1899, hundreds of plague corpses were stored in the mortuaries of this town. Many of the coffins leaked badly, and swarms of flies fed greedily on the juices exuding from these coffins. The caretakers lived in close proximity, their dwelling rooms were full of flies, and their food constantly fouled by them, yet not one of them contracted plague. Judging from this instance, it would seem as if the putrefactive germs rapidly kill the pest bacilli.

DISCUSSION ON RAILWAY, SEA, AND RIVER QUARANTINE

The CHAIRMAN. It appears to me that subsection D 3 has great influence upon our subsequent decisions, especially in regard to railway, river, and sea quarantine, and I am sure the Conference would like to hear the views of those gentlemen who had charge of railway, river, and sea quarantine work. We know that very few rivers were open at that time, but still preparations were made for river quarantine, and I think the Conference would like to hear about them.

Dr. ANDREW. One or two of my impressions of quarantine work during the time I acted as quarantine officer at Chinwangtao may be of interest. One important point which struck me most forcibly at the time was in regard to ships that came to port and the restrictions which were put upon them. We had a great deal of trouble and inconvenience in our work, not from the Chinese, who quietly submitted to any regulations we made, but from foreign ship owners. There was one case in which they absolutely refused to comply with the quarantine regulations and telegraphed to the consuls and ministers, and it was only after an imperial edict came from Peking that we were able to enforce quarantine. In many cases the people responsible for drawing up quarantine regulations were the first to try to break them. As regards railway quarantine, one case came under my notice which pointed to a deficiency in the regulations. About Chinese New Year some fifty merchants from Peking and Tientsin came to Chinwangtao with the object of taking ship to Hongkong and Shanghai. The railway company took them to Chinwangtao, where they expected to be able to take ship, go home, and spend a happy New Year holiday. But when they arrived they found that no ship would take them. When they thought of returning where they had come from, they found the railway company would not take them back. So these merchants found themselves stranded at Chinwangtao, a small village, without sufficient money or clothing, for over a month. It was only after they had presented a petition that we were able, ultimately, to send them back to the places from which they had come.

Dr. PETRIE. Where quarantine regulations were adopted, was any discrimination made between different classes of passengers—as, for instance, between first-, second-, and third-class passengers? Of course it would be difficult to draw distinctions in that way. Still I take it that first-class passengers would be able to furnish an address and could more easily be followed, and, for that reason, there might be some discrimination. I would like to know if any such discrimination was ever made.

Dr. CHRISTIE. The Imperial Railways of north China acted very promptly in stopping traffic. Before other railways did anything we got orders to stop traffic from Mukden, so that only a few were allowed to travel. These were a limited number of Chinese officials, imperial messengers, and trans-Siberian passengers. All the officials and Government messengers were certified by the Mukden foreign office. They received letters from the Mukden foreign office certifying that they had not come into contact with the disease in any way. They underwent medical inspection at the railway station before they were allowed to go forward. Every precaution was exercised. There was a little difficulty in getting trans-Siberian passengers through without some delay, but I do not think that much inconvenience was caused.

Dr. GRAY. Part of the trouble with regard to quarantine of trade articles was that merchants in Tientsin sending cargo to the shipping ports demanded that their cargo should be accompanied by their own agents to supervise the unloading of them. The railway company objected to this and said it would take their cargo, but refused to let any passengers accompany it.

Dr. FARRAR. The point raised by Dr. Petrie is a very important one. In our own experience we were traveling from Changchun and were stopped at Shanhaikuan and, from there, sent forward in a special train. In our train was an English official of the customs, a person whose address could be most accurately ascertained. He was detained and not allowed to go forward with us in the train. In the application of port and sanitary methods in Europe we go upon the principal that any person whose address can be ascertained and who can be identified should be allowed to proceed to his destination. In dealing with persons of the coolie class whose addresses can not be ascertained it is important to quarantine them. I think that, in this epidemic, railway restrictions were applied in certain cases in an unnecessarily harsh manner; particularly in dealing with Chinese, distinction was not always made between the respectable merchant classes and migratory coolies, a class which it was necessary to detain.

Dr. ASPLAND. I should like to have the opinion of this Conference whether it would not be advisable, in the event of a future epidemic, that medical men, whether engaged in plague work or otherwise, should be exempted from all quarantine regulations. This, I believe, exists in most other countries where it is generally the rule that medical men and those connected with medical work are presumed to take the necessary precautions

against the spread of infection and are exempted from the rules which are binding on people in general.

Dr. GRAY. I believe there is no known instance of a first-class passenger ever having conveyed plague from an infected to a noninfected place.

Dr. CHRISTIE said that many of the coolies had a great deal of money and were quite ready to buy good clothes. It would be very difficult to distinguish a well-dressed coolie from an ordinary first-class passenger. The case mentioned by Dr. Farrar was an exceptional case. This man was a postal officer who did not come under the trans-Siberian list, or the official list, or any other known list. Eventually he was allowed to pass because he was on postal business. He thought the authorities at Shanhaikuan did not understand that at first.

Dr. MARTINI. Shantung coolies traveled first class when the order was given that otherwise prevented them from getting home for the New Year.

Dr. CHABANEIX said that with regard to the question of passing through first-class passengers there certainly would be danger of passing through infected passengers, for a Chinese official generally had many servants with him. If one allowed a European passenger to pass one should allow a Chinese official of the same class, and this would cause much inconvenience and very great difficulty in carrying through quarantine regulations. With regard to the question of medical men, at the time of the epidemic they were badly needed. The same regulations had been applied to medical men during the plague epidemic as were enforced in Europe, where there was no quarantine for first-class passengers, but medical inspection only. Medical men, if sick, would isolate themselves, and that was why they should be allowed to pass.

The CHAIRMAN said the question of conveyance of goods was rather important and he believed that great loss had been sustained on account of the detention of goods. He thought they would all like to hear something about that.

Dr. CHABANEIX. During this epidemic the following restrictions were enforced in Tientsin. All goods imported from beyond Shanhaikuan were inspected by the medical officers before they were permitted to be unloaded or allowed to pass. All furs, skins, hides, feathers, bristles, hairs, waste paper, rags, fruits, vegetables, coffins, flowers, and earth coming from beyond Shanhaikuan were prohibited from entering Shanhaikuan.

Dr. FARRAR. I beg to propose that, as it seems probable we can get more information this afternoon, we proceed now with the remainder of the programme, and that we adjourn this dis-

cussion until the afternoon and proceed with our other business. I believe that a certain amount of specific information will be forthcoming this afternoon.

Dr. MARTINI seconded this proposal, which was carried.

ADOPTION OF RULES OF PROCEDURE FOR THE SECOND PART OF THE CONFERENCE [1]

The CHAIRMAN. The suggested rules of procedure are before you, and if it is your desire we will consider them one by one.

Dr. ASPLAND said that efforts would be made to print these rules in another language, probably German, as soon as possible.

Rule 1, proposed by Dr. FARRAR and seconded by Dr. MARTINI, was passed.

The CHAIRMAN then read rule 2.

Dr. CHRISTIE. I propose that in the last line but one, instead of "pneumonic plague" the words "pneumonic or other types of plague" be inserted.

Dr. PETRIE. If that is done it will have to be very clearly stated what measures are to be taken against pneumonic and what against bubonic plague.

Dr. CHRISTIE. We must consider every form of plague because it might break out in other forms, a mixed epidemic for instance. I think the resolutions of the Conference ought to contain general rules and measures for other forms.

Dr. STRONG. My understanding is that this Conference was called for the study of pneumonic plague. Our recommendations, it seems to me, should be upon pneumonic plague only. We should be going very far astray in taking up the question of bubonic plague. We should have to have much more testimony and sit here for several weeks longer.

Dr. CHRISTIE. Then we must make it very clear that our recommendations only apply to the pneumonic form. The Chinese expect us to deal with plague as a whole. They may at another time have an outbreak of bubonic plague, and for this reason I think it would be a pity if you limited yourselves to the pneumonic form alone.

Dr. STRONG. It is my understanding that the Chinese Government has asked us to consider only pneumonic plague.

Dr. CHRISTIE. Probably the Chinese Government does not know the difference.

Dr. ASPLAND said that it might assist the Conference if he read

[1] These rules of procedure, as adopted, will be found at the end of this session, page 320.—[EDITOR.]

the points upon which the Conference was asked for information in the speech of His Excellency Alfred Sze. [This he did.]

Dr. GRAY said that epidemiologically pneumonic and bubonic plague were entirely different, as different as diphtheria and typhoid fever.

Dr. ANDREW. If I may be allowed to say a word from my own experience in China, I can say with the greatest assurance that it would be a terrible mistake to ignore the question of bubonic plague. We know less about bubonic plague than we know about pneumonic plague. If you ignore it altogether I am sure that it will lead to terrible consequences in the future.

Professor ZABOLOTNY. I believe that we must arrive at the conclusion that bubonic plague has existed here in epidemic form as well as pneumonic plague. We can not say what will happen during the summer months. If the Conference is still sitting in May we may find an epidemic of bubonic plague during that month. We can not study pneumonic plague only here. The question can not be divided into two distinct parts. We can not draw regulations for pneumonic plague and leave out the consideration of bubonic plague entirely.

Dr. CHRISTIE. If we leave out the word "pneumonic" it will cover the whole thing. We have had septicæmic plague as well during the past epidemic.

The CHAIRMAN. I would just like to put in a word of explanation. There is no doubt that, when the Conference was called, it was with the intention of discussing the different phases of pneumonic plague. By that the Government probably did not intend the Conference to confine itself to pneumonic plague; thus the bubonic form would have to enter into our resolutions, not, perhaps, as a primary factor, but as a secondary factor.

Dr. CHRISTIE. I move that the word "pneumonic" be deleted.

Professor GALEOTTI. I second that.

Dr. STRONG. If that is done it means we must sit here for several weeks longer and go into evidence and other matters concerning bubonic plague, and must study all the Indian Plague Commission reports, etc.; otherwise our evidence and proceedings will be very incomplete.

Dr. PETRIE. I quite agree with the importance of guiding China with regard to bubonic plague. But, as I understand it, this Conference was formed to guide China in regard to pneumonic plague. As this has been a purely pneumonic-plague epidemic and as we have not discussed bubonic plague, it seems to be going outside our province to consider bubonic plague now and will add considerably to our work. Of course I quite realize the importance of dealing with a bubonic outbreak.

Dr. BROQUET. This is an International "Plague" Conference and not an International "Pneumonic Plague" Conference.

Dr. STRONG. We have excluded all evidence about bubonic plague except in its relation to pneumonic plague. We have interfered with speakers when they have spoken about bubonic plague alone.

Dr. ASPLAND reminded the Conference that when the programme was adopted it was decided to insert the word "past" before epidemic. The past epidemic had been one of pneumonic plague and evidence upon it alone had been placed before the Conference. As they had had no evidence upon bubonic plague it seemed to him that it would be rather contradictory to deal with it now.

Professor GALEOTTI. It would be quite absurd to make any fundamental distinction between different forms of plague because all forms are produced by the same microbe. What would the scientific world say if we made such a distinction? An epidemic of plague can develop in different forms at the same time. Suppose that a bubonic epidemic, as Professor Zabolotny has said, should break out in China during the next few months what would the Chinese Government say if we only suggested measures against the pneumonic form? All our work would go for nothing. I say, with regard to what Dr. Aspland has said, that we can not draw up our resolutions only upon the evidence given to this Conference; we must also use our past experience and what we know from other epidemics; this would, perhaps, be of more use even than the evidence collected in this epidemic. I therefore second the motion of Dr. Christie to omit the word "pneumonic." In our resolutions it could, if necessary, be pointed out which measures are intended to deal with pneumonic epidemics.

Dr. BROQUET. I think that the resolutions should be in regard to pneumonic plague, but that bubonic plague being so well studied already, the Chinese Government can be recommended to follow the measures now adopted against bubonic plague in other countries.

Dr. STRONG. I second that. We can refer to the International Convention at Paris.

Dr. CHRISTIE. That quite satisfies me if it satisfies my second. If bubonic plague is dealt with in that way, I shall be quite willing to withdraw.

The CHAIRMAN. The amendment by permission is withdrawn.

Professor ZABOLOTNY maintained that the rule should refer to plague, not pneumonic plague only.

Dr. GRAY. I think that all are agreed that different forms

of plague have the same origin. At the time of the outbreak of the epidemic, when the Government came to Chinese and foreign doctors for advice, we turned for information to the voluminous literature upon plague, such as the reports of the Indian Plague, the Austrian, and other Commissions. In the huge volumes of the Indian Plague Commission's Reports pages were turned over by the hundreds, but we found nothing that gave us any useful light upon pneumonic plague. There was only one short paragraph upon pneumonic plague in the report of the Austrian Commission. Nevertheless we went ahead and got out rat measures and other preventive and administrative measures. It was soon seen that these were useless. It was with a view to the elucidation of this question of pneumonic plague that this Conference was called. The Chinese Government knows very well that there is a vast amount of bubonic plague literature.

Dr. BROQUET. I meant to express the same views as Dr. Gray.

Professor ZABOLOTNY suggested that the words "plague in its different forms" should be inserted before the words "as may occur."

Dr. STRONG. "Such as may occur" covers that, I think.

Dr. FARRAR. Dr. Broquet has stated that, in his opinion, it would suffice if we state that the conclusions we have arrived at and the suggestions we make refer to pneumonic plague only, in respect to which only evidence has been before us; and that the measures adopted for dealing with other forms of plague are already before the world.

The CHAIRMAN. I think that Dr. Broquet's proposal is covered by the words "such as may occur."

Dr. ASPLAND. For the relief of those who do not see their way clear now, I may say it is quite open to them to add a rule in these rules of procedure, referring the Chinese Government to the literature on bubonic plague.

The CHAIRMAN. It is proposed by Dr. Broquet and seconded by Dr. Strong that this rule be passed in its original form.

This resolution was carried, Professors GALEOTTI and ZABOLOTNY dissenting.

The CHAIRMAN. We will now pass on to rule 3.

Dr. STRONG moved and Dr. MARTINI seconded the adoption of this rule.

Dr. BROQUET. I ask that Dr. Chabaneix be allowed to take part in the discussions at these sessions, although he is only on the list as a deputy. His experience of railway matters, and

the plague work he has done make him specially fitted to give information. I would regret to see him called in simply as an ordinary witness.

Dr. FARRAR. If Dr. Broquet's proposal is carried, the same thing must apply to others who are here. I think we must confine ourselves to Delegates only.

Dr. STRONG. I should be very glad to second this amendment. I am sure that many members of the Conference feel that Dr. Chabaneix has given very valuable information. I believe we all feel that. But I do not see how we can allow anyone on these committees except Delegates. Otherwise there are a great many other gentlemen here who would have to be included also. If the French Government signified its intention of appointing Dr. Chabaneix as one of its Delegates, there could be no objection to his attending.

Dr. BROQUET thought that the matter ought to be referred to the Chairman.

The CHAIRMAN. Dr. Chabaneix is a deputy from the Chinese Government and not from the French Government.

Dr. BROQUET. I regret that there should be any discussion upon this matter. I believe that Dr. Chabaneix's evidence would be very useful as his work in connection with railway and preventive measures has been most valuable. All I have said has been absolutely spontaneous.

The CHAIRMAN. We appreciate the services of these gentlemen who have given evidence before the Conference. All the excellent material that has been placed at our disposal has been fully reported, and the reports will be open to those Delegates who desire to inspect them. Our duty now, as Delegates from various countries, is to recommend measures to the Imperial Chinese Government from the evidence so far gathered, and also from our own personal observations, and I am sure that the Conference will agree that this would be rather difficult if we do not adhere to the rule that the recommendations shall be formulated by the Delegates only, appointed by their various Governments to attend this Conference.

Rule 3 was then put to the meeting, and carried.

Rules 4 to 7 were each proposed, seconded, and carried without opposition.

In regard to rule 8, Dr. HILL asked whether it would not be better to have a time limit. He suggested as an amendment the insertion of the words "not later than 4 o'clock" before "on the day preceding."

Dr. FARRAR said that the Conference must bear in mind that the secretarial staff was very hard worked, and that it should endeavor to be

reasonable in the matter. Each committee appointed should consider it its duty to facilitate the work of the secretariat.

Dr. PETRIE said that he understood that the object of this rule was to allow the Delegates to give due consideration to the recommendations.

Dr. HILL'S amendment, seconded by Dr. FARRAR, was then put to the meeting and carried.

Rule 9:

Dr. GRAY moved an amendment to insert the words "not later than 9 a. m." This was seconded by Dr. PETRIE, and the rule was adopted with this amendment.

Rule 10:

Professor ZABOLOTNY thought that each Delegate, if he wished, should be permitted to record his vote in the subcommittees.

Dr. FARRAR said that he could quote, as a precedent for this rule, one passed by the Opium Commission.

As no one seconded Professor ZABOLOTNY'S amendment, the rule was put to the meeting in its original form and carried, Professor ZABOLOTNY alone dissenting.

Rule 11, proposed by Dr. GRAY and seconded by Dr. DI GIURA, was carried.

Dr. FARRAR said that if resolutions provided for under rule 11 were handed to the Medical Secretary, they ought to be posted on the board so that everyone could see them. Otherwise the Medical Secretary would be the sole possessor of the information.

Dr. STRONG said that he supposed that the Medical Secretary would naturally put them up on the bulletin board.

Dr. FARRAR then moved the addition of the words "and a copy of such resolutions shall be forthwith posted upon the notice board by the Medical Secretary."

This was carried. Rules 12 to 14 were then proposed, seconded, and carried *nem. con.*

This concluded the discussion of the rules proposed.

Professor GALEOTTI moved that an additional rule be added that if the Delegates do not agree unanimously to a resolution in regard to recommendations, the opinion of the minority shall also be inserted in the report to the Imperial Government, with the names of the delegations.

Dr. MARTINI seconded this.

Dr. PETRIE suggested that it would add greatly to the strength of the recommendations of the Conference if the recommendations were formulated unanimously.

Dr. CHRISTIE. Allow me to express the view that in China I do not think the views of the minority should be reported at this stage. I think the recommendations must be the unanimous opinions of the Conference and that the views of the majority alone should be stated.

Dr. FARRAR said that supposing six agreed with a certain proposal and five disagreed, it was rather hard that the recommendation should be stated as the concluson of the Conference when the five in no wise agreed with it.

Dr. CHRISTIE suggested that a difficulty of this kind might be overcome by a certain amount of give and take.

Professor GALEOTTI. Of course we shall try to have these resolutions unanimous. We shall do everything possible to agree. But it is not always possible to be unanimous.

Dr. CHRISTIE said that he thought that it might be decided upon each point whether the views of the minority were to be recorded.

Professor GALEOTTI said that this report would not only be studied in China, but would go all over the world.

Dr. GRAY said that he was entirely of Dr. CHRISTIE'S opinion that they ought to be unanimous if possible.

Dr. STRONG suggested that the minority, if it wished, could make a special report.

The CHAIRMAN. This seems to be rather an important matter, and, if there is any difference of opinion, I am sure the Conference would like to hear of it now.

Dr. STANLEY. I think that in making recommendations for the future to a country like China, which is in its sanitary infancy, recommendations ought to be as definite as possible, and the opinion of the majority should be taken when making the recommendations. If we send two recommendations upon one point, I think it will make it very difficult for China to take a proper course of action.

Dr. STRONG said that he thought the matter ought to be left until the time arrived when there was a difference of opinion—that is, if they found that there was some point upon which they could not agree.

He moved that Professor Galeotti's resolution be left on the table until the time arrived for it to be considered.

Dr. FARRAR seconded this proposal.

The motion to lay the resolution on the table was carried, only Professors Galeotti and Zabolotny dissenting.

ELECTION OF COMMITTEES

Dr. FARRAR proposed that Drs. Kitasato, Ch'uan, Strong, Gray, and Zabolotny be appointed as the committee upon Section A, subsections 1 and 3 a of the programme.[1]

The CHAIRMAN said that he would like to be informed why subsection 2 and many others on the programme were not to be inquired into by committees.

Dr. FARRAR said that several Delegates had drawn up these proposals. The questions of rats and other animals had already been fully discussed in the Conference, but it seemed to them that they had not had sufficient information with regard to the origin of the outbreak and its relation to the tarbagan. It might be found necessary that these should form the subject of further investigations. Upon the other points, it was considered that they already had ample information.

The committee proposed by Dr. FARRAR and seconded by Dr. MARTINI was then elected.

Dr. ASPLAND said that he desired to withdraw from the proposed committee to deal with D 2 a to f.

After some discussion the CHAIRMAN nominated the following committee: Drs. Stanley, Christie, Zabolotny, Uyama, and Teague.

Dr. DI GIURA seconded this, and the committee was then elected.

Dr. MARTINI proposed and Professor Kitasato seconded the election of Drs. Shibayama, Hehewerth, Broquet, Worell, and Hill to deal with D 2 g. This was carried.

Drs. Wu, Farrar, Di Giura, Gonzalez, and Haffkine were elected to deal with D 2 h to j.

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[1] For the complete programme see pages 14 to 17.

Drs. Gray, Farrar, Christie, Hehewerth, Galeotti, Zabolotny, and Kitasato were elected to deal with D 3.

The Conference then adjourned until the afternoon.

RULES OF PROCEDURE

1. The following rules of procedure shall apply to the second part of the work of the Conference, namely, the drafting of an Interim Report embodying recommendations to the Imperial Government based upon the evidence already laid before the Conference.

2. Interim Report.—That the Interim Report to the Imperial Government shall consist of two parts:

a. A brief statement of conclusions based on the evidence laid before the Conference to be drawn up by the editorial committee. These conclusions to be laid before the Conference in *plenum* session for discussion and revision, and when confirmed to be submitted to the Government as provisional conclusions.

b. Recommendations to the Imperial Government of administrative measures which in the opinion of the Conference should be adopted with a view to the prevention of future epidemics of pneumonic plague or the control of such as may occur.

3. That the session of the Conference and of all committees elected under these rules shall be held in private, Delegates only being admitted, and no reporters shall be present nor shall any statements regarding the work of these sessions be given to the press, pending the issue of the Interim Report.

This rule shall not be held to preclude the Conference or any of its committees from calling such witnesses as they may deem necessary for the purpose of eliciting additional information.

4. When a vote is taken in *plenum* session or in committees, each delegation shall have only one vote, the means of exercising and conveying the vote to be left to the discretion of each delegation; on questions of procedure and discipline, the Chairman, in the event of a vote being equally divided, shall have a deciding vote.

5. That committees shall be formed for the purpose of considering and framing provisional recommendations in accordance with rule 3, such recommendations being submitted to the Conference in *plenum* session for revision and confirmation.

6. That committees may be nominated by the Chairman for the approval of the Conference. In the event of such nominations not being accepted by the Conference the manner of forming the committees shall be as follows:

Each delegation shall hand in the name of one of its members to the Chairman; the selected Delegates shall subsequently meet to decide upon the number and constitution of the committees. Committees thus formed may complete their own organization.

7. The Chairman and the Medical Secretary shall be eligible as members of committees but not be *ex officio* members.

8. That a copy of the provisional recommendations framed by each committee for the consideration of the Conference shall be furnished to each Delegate not later than 4 o'clock on the day preceding the consideration of such resolutions by the Conference in *plenum* session.

9. That a daily notice shall be posted not later than 9 a. m. of the time at which the several committees shall meet.

10. Any Delegate may attend meetings of any committee, but, unless a member of that committee, shall not take part in its proceedings.

11. Any delegation may suggest resolutions to the Conference, provided that such resolutions shall have been handed in in writing to the Medical Secretary not later than 4 o'clock on the preceding day; and a copy of such resolutions shall be forthwith posted upon the notice board by the Medical Secretary.

12. That the minutes of the session of the Conference shall give a brief résumé of the deliberations, and that a copy shall be opportunely furnished to the Delegates, and that the minutes shall be submitted to the Conference for confirmation and shall be taken as read at the beginning of each session unless specially called for.

13. That English, Chinese, French, and German shall be recognized as the languages to be used at the sessions of the Conference and committees.

14. That, except when otherwise decided by the Delegates, the *plenum* sessions shall commence at 10 a. m. every morning.

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SESSION XVI, APRIL 20

PROGRAMME ARRANGED FOR THE DAY

Preliminary business.

E. The Effect of the Epidemic on Trade.

1. Bean trade.
2. Wheat and flour trade.
3. Skins, furs, human hair, etc.
4. Coal.
5. Railway traffic.
6. Other trades.

PRELIMINARY BUSINESS

The meeting came to order at 2.30 p. m., Dr. Wu in the chair.

The Secretary made an announcement in connection with the visit of the Delegates to Harbin.

Dr. Farrar stated that he has been requested to say that Dr. Wörster had prepared a paper for the Conference on the subject of rodents and other animals susceptible to plague in Manchuria and Mongolia. It was decided by the programme committee that it would be out of order to have this paper presented, because this portion of the programme was already completed, but certain members had requested him to bring the matter before the Conference, and ask if it would be willing to hear this evidence.

The Chairman asked Dr. Wörster to withdraw while the matter was being discussed.

Dr. Strong asked how long it would take to read the paper.

The Chairman. I think this paper ought to be submitted to the programme committee first to examine its value.

Dr. Farrar said that he understood that the paper would be ready the following morning. Dr. Wörster at first said that it would take an hour to read, but when he was told that this was too long, he said that he could condense it into twenty minutes.

Professor Kitasato said that he would like to hear the paper, and suggested that an opportunity should be given for it to be read informally.

Dr. Aspland suggested that the paper might be considered by one of the committees.

Dr. Strong suggested that the Conference receive it the following day, in order that the evidence might be as complete as possible, and that the Conference now pass on to the regular programme of work.

The Conference then proceeded to deal with the afternoon's programme, namely:

THE EFFECT OF THE EPIDEMIC ON TRADE

The Chairman said that he supposed that the whole question depended practically upon whether valuable commodities like wheat, flour, skins, hair, coal, etc., actually were infected.

Dr. PETRIE said, with regard to coal, he believed that in big coal-mining centers certain restrictions had been placed upon it—as, for instance, during the Tongshan epidemic.

Dr. ANDREW said that, fortunately, during the recent epidemic, none of the centers which had coal mines were infected to any extent, so that the question of the infectivity of coal had not been brought up; but he could give them some particulars of what had happened two years ago in Tongshan when restrictions were placed upon coal. This place contained one of the largest coal mines in China. The underground workings altogether extended over 50 miles. During that epidemic five cases of plague were contracted below the ground in the mines. Of these three had not vomited, defecated, nor expectorated in consequence of the disease in the mine and were able to work, but two cases suffered severely while in the mine and were evidently in the more advanced stages of plague. There were very erroneous opinions in regard to the infectivity of coal. A report which he had in his hands was written by one of the best known medical practitioners in China, who expresses his views as follows:

> I believe that coal may serve as a means of distribution of the germ, and, under these circumstances, can not recommend too strongly the absolute and essential need of the strictest measures to prevent plague patients obtaining admission to the workings or of becoming ill below, and the great importance of immediately notifying the occurrence. The danger that has to be borne in mind is that people who have suffered from plague but who are sufficiently well for work, may infect for at least two weeks after their recovery. The fæces of a convalescent from plague are infective for certainly two weeks after the disappearance of the last symptom.

Then he goes on to recommend that on account of infection the mine ought to be flooded. Fancy flooding 50 miles of underground workings! He brought this up simply to give an idea of what people thought about plague in China. After these five cases of plague occurred, the output of dust coal from the mine was completely stopped, and the loss involved to this company was over $100,000. He might, perhaps, also read a short extract from the report of the engineer in chief, probably one of the best engineers in China, who says:

> In the case of goods, free exportation was permitted for bricks, cement, coke, oil, wood, stone, etc.—in a word, for goods which could not be infected by excretions or give shelter to rats and fleas. Strangely enough, the exportation of dust coal was prohibited, while full freedom of movement was allowed in the case of lump coal. It is true that cases of plague had been found among the miners, some of whom had been sick in the mine, and the medical authorities considered that there was danger of contamination of the coal by their expectorations, excretions, or vomit. Admitting that such contamination was possible, it is rather difficult to

understand how the lump coal which is raised from the mine in the same tubs as the dust and is mixed with the latter could escape contamination, while the dust is declared infected.

During this period a large quantity of dust coal was sent to stations along the railway, but not a single case of plague was found along the railway. He thought it a very serious thing if trade were interfered with in this way without, as far as he could see, any rhyme or reason. The loss of $100,000 was incurred simply because the sanitary authorities said that dust coal could carry infection. He thought it was an important duty of the Conference to make some definite statement as regards the exportation of coal, as this point was sure to be raised within the next year or two.

The CHAIRMAN said that one of the staple industries of Manchuria was the bean trade and he felt sure that the Conference would like to hear the opinion of experts upon this question.

Dr. PETRIE asked if any restriction had been placed upon the transportation of beans during this epidemic.

Dr. CHRISTIE. Not as far as I know.

The CHAIRMAN said there had been a great deal of talk about exposing the beans to sunshine just before sending them away, and, if there were any need to do this, the Conference should come to some conclusion regarding it.

Dr. PETRIE said that he could quite understand the danger of beans being infected by the presence of rats. In such circumstances their exportation might involve danger, but in an epidemic consisting entirely of pneumonic plague it was very difficult to see how beans could carry infection.

Dr. STRONG asked in what way Dr. Petrie meant that the beans themselves ever could carry infection.

Dr. PETRIE replied that rats were very fond of beans, grain bags, and so on. It might be possible that infected rats might get distributed among the beans.

Dr. STRONG. Do you mean that the rats would be among the beans?

Dr. PETRIE. Live rats have been found inside half-filled grain bags, and so I say that it seems a possibility that infected rats might get among the beans.

Dr. FARRAR. There is a very grave likelihood. It is almost impossible to transship beans or other grain without at the same time transshipping rats. I can remember an instance in which maize was consigned from Odessa to Hull, and plague-infected rats were landed with the maize. At least 40 rats died around

one bag of Odessa maize. It is almost impossible, when transshipping cargo of this kind, even when exercising very great care, to guard against transshipment of rats with the cargo. In this particular warehouse in Hull a consignment of maize was received from Odessa. At first one or two rats became infected and died. One day the warehouse cat, quite a healthy animal, also got infected and died. Subsequently, around one particular sack at least 40 rats dead from plague were found. They were examined, and it was proved that they had died from plague. It is well known that Cardiff and other harbors have been similarly infected.

Dr. GRAY asked if in the recent epidemic there was a single specific instance of pneumonic plague being introduced to a non-infected port by infected materials. He thought not.

Dr. STRONG said that he quite agreed. He did not see how the shipment of grain, peas, beans, or coal could be likely to carry pneumonic-plague infection. The shipment of infected rats was another matter.

The CHAIRMAN said there was also the question of wheat and flour. In Harbin there were large shops where wheat and flour were sold. These houses were shut up and their contents disinfected when a case of plague occurred in the building. Sometimes the flour and wheat were spoiled. He thought that the Conference should decide whether these goods were liable to be infected or not, because, if there was no need to disinfect them, they were putting very harsh restrictions upon the people.

Dr. FARRAR said that, as far as he could see, great precautions were needed in transshipping beans. All hawsers should be tarred every day. The gang planks should have sentries over them, and all gang planks should be taken up at night. Also the ships should be carefully hunted for rats.

Dr. STRONG. These are the usual precautions taken against carrying rats on ships.

The CHAIRMAN said that he would like to know what their Russian colleagues in Harbin did when they found cases of plague in shops where wheat and flour were sold.

Professor ZABOLOTNY said that in Harbin nothing was done to wheat and flour during the epidemic of plague pneumonia, because there was no plague among rats. In Odessa destruction of rats was effected with Clayton gas. In flour shops, bakeries, etc., superficial disinfection with a 25 per cent lime solution was used. The floors were made rat proof in houses in which flour and other grains were stored.

Dr. FARRAR asked Dr. Stanley whether in Shanghai or other treaty ports they had Clayton gas apparatus, and what had been the effect of this epidemic on trade in these ports, if any.

Dr. STANLEY said that he believed that the effect on Manchurian trade was not great; there had been no special restrictions put upon Manchurian produce. They had no Clayton apparatus in Shanghai, but used sulphur burnt in open pans.

Professor KITASATO said that they had two carbon monoxide disinfecting boats in Dairen.

The CHAIRMAN asked what had been done regarding importation of beans and flour into Japan.

Professor KITASATO said no measures were taken against the import of beans and flour from Manchuria during the epidemic.

The CHAIRMAN asked what was done in a case where plague broke out in storehouses.

Professor KITASATO. That has not happened.

Professor ZABOLOTNY said that this question had also arisen and it had been referred to St. Petersburg for instructions what to do in such cases, but they had not had occasion to disinfect grain and storehouses.

Professor KITASATO said that what he had stated referred only to this epidemic of plague pneumonia. If there were an epidemic of bubonic plague, measures would immediately be taken against rats.

Dr. ANDREW said that he begged to suggest that from all the evidence put forward at this Conference there was none of any kind whatsoever in support of even a house, in which a case of pneumonic plague occurred, being infectious. They ought to put away all thought of disinfecting any kind of goods whatever. The mere fact that plague bacilli might be found in the sputum in infected houses did not mean to say that the house was infectious so far as inhabiting it was concerned. He thought they should dismiss all idea of restrictions upon cargo because of infection.

The CHAIRMAN said he was very anxious to know something about these questions because in Harbin there were many kinds of shops in which flour, beans, and other produce were stored. The question was whether flour and wheat ought to be disinfected or whether they ought just to move the flour and beans outside the house and disinfect the empty house. If these articles were disinfected unnecessarily, it was a great hardship on the people.

Professor ZABOLOTNY said that in cases where bags of flour were contaminated with sputum they would be brought out and left in the sun for some hours, being turned around from time

to time. They would be disinfected in this way or by superficial disinfection with lime.

Dr. PETRIE. Does Professor Zabolotny think that there is much danger of infection from the outside of grain bags apart from fleas?

Professor ZABOLOTNY said he did not think so.

The CHAIRMAN said that he believed that skins, furs, and human hair had suffered most because they were not admitted into Europe at all. But it was a question of how far they were infected.

Dr. STRONG. The main question is the hunting of the tarbagan on which subject we already have named a special committee to report.

Dr. PETRIE asked if there were any evidence of the infection of skins.

The CHAIRMAN said that he thought Dr. Chang had mentioned the case of a large Russian warehouse where the skin trade was carried on and no one had died.

Dr. ANDREW had said that during this epidemic hides were allowed to be brought down. There was one case in which there was a very large consignment of hides at Changchun and they tried very hard to get them sent to Tientsin, but they were unsuccessful.

Dr. FARRAR said that he thought it was very necessary that evidence should be laid before the Conference as to what the effect upon trade had been, as this question affected not only China but Europe. The trade of China would be very much hampered in the immediate future if needless restrictions were placed upon it. It was quite possible that His Excellency Alfred Sze might be able to procure details of the effect upon trade and, although there was no committee to consider this point, it might be taken up by the committee on D 3.

Dr. STRONG said that he thought details of this kind would be valuable if they could be secured.

Dr. FARRAR said that he thought the subject had been well discussed, and proposed that the Conference should now adjourn.

Before adjourning, the Conference decided to consider the resolutions of the vaccine and serum committee at the following session.

SESSION XVII, APRIL 21

PROGRAMME ARRANGED FOR THE DAY

I. Resolutions on the question of prophylactic inoculations against pneumonic plague.
II. Discussion on the negative phase following inoculation of vaccines.
III. Railway quarantine in Manchuria and Chihli.

RESOLUTIONS ON PROPHYLACTIC INOCULATIONS

The meeting opened at 10 a. m. with Dr. Wu in the chair.

The minutes of Sessions XV and XVI were accepted.

The CHAIRMAN. This is a *plenum* session for the discussion of *Resolutions on the question of prophylactic inoculations against plague pneumonia.* These resolutions have already been circulated among the Delegates.

Dr. STRONG. I move that they be adopted. The matter has already been considered very thoroughly by the committee, and so I move that the resolutions be passed by the Conference.

Dr. FARRAR. I second that resolution. I may add that they represent very hard work and close discussion for six hours by the committee which framed them, and I think it will be found that they are absolutely the closest that we can get to a unanimous decision. If we fight all day we shall never get closer to a unanimous decision than now.

The CHAIRMAN (Dr. WU). These resolutions are open for discussion by the Conference now.

Not as chairman of the Conference, but as the chief Delegate for China, I am instructed to inform you that the Chinese Government spent over $100,000 on vaccines during the recent epidemic, and I think the conclusions arrived at by the majority of doctors who worked were that the vaccines we obtained did not justify expectations. The Government desires to get the views of the various Delegates as to whether, in the event of a similar epidemic in the future, it would be necessary to procure a large stock of similar vaccines, and also, in case you recommend that, that you will recommend the best and most efficient.

Dr. FARRAR. I submit that in these resolutions we give it as our opinion that a certain kind of vaccine represents at the

present time the simplest, safest, and best method of vaccination against plague, and this amounts to a definite recommendation. We recommend that vaccines should be used. We recommend further experimental work on animals and also experiments upon selected communities in the event of a further outbreak, as well as laboratory experiments in order to make further inquiry into the question. That I submit is all that we can do. These recommendations are quite as definite as we can arrive at, and to prolong the matter any further would only lead to useless discussion.

Dr. WU. As the impartial chairman, gentlemen, I see the sense of these recommendations, and that we as a Conference can not do more than recommend these proposals to the Government, so I will only just say this, that Dr. Strong has proposed and Dr. Farrar has seconded that these resolutions be passed, and if there is no amendment I shall put them to the vote.

The resolutions which follow were then put to the vote and carried unanimously.

RESOLUTIONS ON THE QUESTION OF PROPHYLACTIC INOCULATION AGAINST PNEUMONIC PLAGUE

1. The statistical evidence points to the conclusion that some degree of protection is conferred against bubonic plague by the use of vaccines.

2. Therefore, there are *a priori* grounds for the use of inoculation with vaccines as a means of protection against pneumonic plague.

3. The statistics which have been collected during this past epidemic do not allow us to come to any definite conclusion about the value of active prophylactic inoculation against pneumonic plague.

4. Many methods proposed for producing immunity against plague have been considered by this Conference; of these some have been already largely used on human beings; others are still under trial.

a. Those already largely used are:

(1) Dead bacilli vaccines—

(*a*) Bouillon cultures.

(*b*) Agar cultures.

(2) Nucleoproteid vaccines.

(3) Mixed dead bacilli and serum combined.

b. Those under trial:

(1) Living attenuated cultures.

(2) Living cultures and serum combined.

5. Dead bacillary vaccines can be simply prepared, and in one form or another have been extensively used in different parts of the world. There is a considerable amount of evidence to the effect that preparations of this kind can confer some degree of protection against bubonic plague, and the method of agar culture affords some advantage in respect to quickness of preparation. It is the opinion of the majority of this committee that killed cultures represent at the present time the simplest, safest, and best method of vaccination against plague, and this opinion is expressed without prejudice to the use of other methods of vaccination or vaccination combined with serum, should such be proved to offer greater advantage.

6. *Lustig and Galeotti's vaccine.*—This preparation seems to have given excellent results experimentally on animals, and can be as safely used as other vaccines. It has the advantage that without losing its properties it can be conveniently stored in a dried form.

7. *Strong's method.*—This is worthy of careful consideration. The results obtained by experiments on animals and on human beings are so striking as to make it important to collect more evidence as to the safety of the method as a practical prophylactic on a large scale.

8. We offer the following advice, (a) that experiments on animals (guinea pigs, white rats, and monkeys) should be carried on by the method of inhalation in order to find out which vaccine can be best used against pneumonic plague; (b) that should another outbreak of pneumonic plague occur, the above methods of vaccination should be tried in selected communities (as in India) under rigorous scientific conditions.

THE NEGATIVE PHASE FOLLOWING INOCULATION OF VACCINES

Dr. STRONG. I understand now that the other subjects under the heading of "Vaccinations, etc.," are open for discussion. On reading over the records I see that Subsection D 1 b has not yet been completely and satisfactorily discussed. I desire to refer particularly to the question of the negative phase in regard to which the evidence seems to be somewhat confusing. I should like to ask Dr. Haffkine what he means by the negative phase. Whether he means that after inoculation there is for a time a period of hypersusceptibility to plague infection, or whether he means that during this period of negative phase there is no additional immunity against plague infection. I think it is a well-known fact that after the inoculation with dead bacteria immune bodies are usually already demonstrable in the serum

after three or four days, and that their maximum is reached after about seven days' time. Therefore, I should like to ask Dr. Haffkine what he means in regard to this negative phase lasting for a period of ten days.

Dr. HAFFKINE. I think there is hypersusceptibility after inoculation. The human body is weakened by inoculation. I only found four cases in which plague was contracted twelve days after inoculation. All the others who got infected were infected in the first days after inoculation; therefore, it seems probable to me that there is a negative phase and that it is the exception for cases of plague to occur after it is past.

Dr. STRONG. Do you think that a negative phase lasts for ten days?

Dr. HAFFKINE. Many cases died in the first days after inoculation, and that I think points to a state of hypersusceptibility.

Dr. STRONG. What is your evidence for believing in a state of hypersusceptibility?

Dr. HAFFKINE. It is my hypothesis only.

Dr. GRAY. I believe the Russian doctors said that there was evidence of a negative phase based upon Wasserman's test. [Deflection of complement.]

Professor GALEOTTI. I wish to say that it is impossible to found any bacteriological hypothesis upon the fact because four inoculations have been unsuccessful. No experiments upon animals have yet demonstrated that after the first inoculation there is a greater susceptibility. The phenomena of anaphylaxis shows much later on, perhaps after twelve or eighteen days. There are only the conclusions of Wright as regards opsonins. He says that the production of opsonins is less after the first days of inoculation. But immunity can not depend entirely upon the quantity of opsonins. As Dr. Strong has said the production of immune bodies begins very quickly after the first inoculation. Anyhow it is impossible to found any hypothesis upon the basis of four cases. I should not think that the Conference ought to go further on with the subject of the negative phase upon this hypothesis.

Dr. FARRAR. I think it ought to be dealt with by resolution. I suggest the following resolution:

"There is no evidence before the Conference as to hypersusceptibility to infection in consequence of a negative phase immediately following inoculation with vaccine; but this is a question which requires further evidence."

Professor GALEOTTI suggested that the resolution ought to begin: "There is neither evidence nor theoretical basis."

Dr. STRONG. The evidence upon the record now shows the idea of the Conference about the negative phase. I do not think it is necessary to pass a resolution upon the subject unless the Conference particularly desires it.

Professor ZABOLOTNY. Dr. Haffkine made a study of this matter, and his experiments show that the negative phase has no important value. Wright's investigations were only in regard to opsonins and had nothing to do with immunization. Calmette's investigations were only done with a few animals. I conclude that the cases mentioned by Dr. Haffkine can not be taken as examples showing that a negative phase exists. Perhaps the immunization for some reason was not sufficient by the method adopted.

Professor SHIBAYAMA. We lost only two cases within three days after inoculation, but many patients were saved who were inoculated, and afterward had chances of getting infected during the so-called negative phase.

Professor KITASATO. I spoke about that the other day. The patients who contracted disease a few days after inoculation did not die but recovered very soon. Among many persons exposed to infection after inoculation only two were infected, and they recovered.

The CHAIRMAN. Is there any more discussion? If not, may I just note two cases which came under my own notice.

During the last epidemic nothing was so interesting as the question of the negative phase, first, regarding the length of time after inoculation in which the staff ought not to be sent to work, for if there were any such thing it would not be right to send people to work before that phase had passed; and, secondly, the negative phase was stretched from time to time to five, seven, and ten days, showing that there was not much certainty about it. Two cases came under my observation. The first was that of Liu, the student who died; he worked for a whole month without any precautions of any kind beyond masking the entrances to the respiratory tract. He never became ill once. On January 2 the vaccines came, and he was inoculated. Eight days after that he was dead; that meant that he probably got infected within six days after inoculation with vaccine.

The second case was that of Dr. Hsu, who also died. He was inoculated on January 4 and became ill on January 22, eighteen days after inoculation. At the same time it is necessary to remember that out of twenty men or so who were inoculated at the same time no others got infected at all. The negative phase is a very important question, because we should be in a position to decide how soon after inoculation we are justified in sending a

man to his work. If there is no negative phase, of course, a person can go on working as soon as he is inoculated. We will now pass on to the second part of the programme, and I will ask Dr. Gray to read a paper on *Railway quarantine work.*

RAILWAY QUARANTINE IN MANCHURIA AND CHIHLI

By Dr. Gray

The past epidemic has shown in a striking way the necessity for an agreement between the three railway companies throughout Manchuria and Chihli with regard to a uniform system of sanitary defense, not only for their own interests, but in order to safeguard the public health of the population along their lines, to whom disease can be brought from infected areas.

The following suggestions involve no interference on the part of one company toward another, and do not do more than sketch on the broadest lines a scheme of combined, permanent, sanitary defense which will obviate the repetition of such incidents as have happened in the past, whereby each railway has adopted quarantine regulations differing both as to time of commencement and relaxation, and in other details from the others.

Measures proposed.—From Manchouli to Peking and Dairen, the Chinese Eastern Railway, the South Manchuria Railway, and the Imperial Railways of North China should agree to regard the line, for medical purposes, as one continuous railway, subject to one continuous sanitary system with quarantine stations at definite points.

If infection breaks out at a certain area, all coolies and others coming from that area should be technically regarded as contaminated and the line up to the nearest station (lazaret) should also be regarded as contaminated. It, therefore, becomes important to diminish the length of contaminated line, not only from an economic point of view but to lessen the chance of escape of people belonging to the irresponsible, coolie class.

The position of these quarantine stations will depend to a great extent upon the recommendations of the authorities immediately concerned, who know the local conditions of trade and the districts or stations between which there is the most traffic.

With a view of illustrating my scheme I would suggest the following places as apparently suitable for the erection of quarantine stations: Manchouli, Tsitsihar, Harbin, Changchun, Mukden, Chingchow, Dairen, Shanhaikuan, and Tientsin. [See map, Plate XV.]

The selection of the most suitable sites, however, could well be left in the hands of a special committee or board.

It would be advisable to adopt a uniform type of quarantine station. This would simplify matters considerably, as the people would become more readily accustomed to the conditions of life while undergoing quarantine. Coolies would soon get to know their proper quarters and the routine of the lazarets if all were arranged and managed on a uniform plan. It would obviate the chance of more rigorous measures being carried out in one place than another, and it would not be left to the unaided efforts of this or that local authority to erect a station which might be far from ideal.

The following points are of importance in the erection of the quarantine stations:

1. An abundant and good water supply.
2. As big an expanse of land as can be spared for the erection of the various buildings.
3. Hospital for plague cases. Segregation buildings (on the box plan) for suspects and contacts.
4. Administration buildings.
5. Disinfection apparatus and bath accommodation.
6. Store for purchase or supply of provisions.
7. Accommodation for a railway guard, as coolies usually submit unwillingly to quarantine.
8. Sewage disposal. A good system should be installed at the beginning as it will be the cheapest in the end.
9. A surrounding fence, perhaps of barbed wire.

These proposals can best be carried out by one body of men.

I suggest that a joint sanitary board be formed consisting of two medical representatives from each railway—that is to say, the Russian, Japanese, and Chinese companies—whose sole business would be concerned with the permanent, sanitary defense of the railways of Manchuria.

As an alternative, until it could be seen how the scheme worked, it would be possible to appoint for a year a railway medical commission, which, if successful, could be made permanent.

Such a board or commission need not deal in any way with the encroachment of one company on the property of another. It would be only concerned with arrangements as to the working of a united system of quarantine for the mutual benefit of the companies involved. This would lie mainly in the direction of such measures as:

1. Prompt notification of any outbreak of infective disease, so that the other two companies would receive the earliest possible warning.
2. The intercepting of contaminated coolies and others.
3. The passing along of gangs of coolies set free from quarantine.

4. The regulation on an organized plan of the 200,000 coolies who annually come north and return south.

5. The supervision of immigrant colonists, Hupeh refugees, etc., while they are in the railway area.

6. Agreement generally as to what articles of trade are to be allowed or prohibited for carriage by rail.

7. The supervision of accommodation en route.

It may be said that coolies can pass along the road and enter at a point beyond a quarantine station, but this could not occur to any great extent, as the railway authorities generally know from which locality these people come and could refuse to take them as passengers in addition to notifying the board.

Moreover, the spread of infection by road is of much less danger than by rail, as it is slower and more difficult where long distances are involved, such as a journey south through Manchuria.

In those places where lazarets of a more or less permanent nature are already built, they need not necessarily be pulled down, but could be adapted so as to come into line with the other stations which are not yet built.

Station masters en route would be able to report to the sanitary board, for its information, the occurrence of any suspicious cases in the neighborhood of their stations. The company under whose jurisdiction the cases might occur would deal with them in the usual way by its own medical staff. It would be only in the question of spread along the line that the international sanitary board would concern itself.

A scheme on similar lines has been found to work well in practice on the Hedjz Railway in the Near East under an international sanitary control, and whether this proposal that I lay before you be accepted or not by the three powers concerned, there can be little doubt but that it is highly advisable.

Dr. ASPLAND. I should like to propose that the paper we have just listened to should be handed on to the committee discussing D 3.

Dr. STRONG. I second the motion.

Dr. FARRAR. It will go into the report, I suppose.

Dr. ASPLAND. I think it would be out of order to go into the report.

Dr. STRONG. In my opinion it should go into the records somewhere. I move that it be entered on the minutes for this full session and go to that committee for discussion.

Dr. MARTINI seconded this proposition, which was carried *nem. con.*

Dr. ASPLAND. I would like to ask whether this is going to be established as a precedent for all succeeding sessions, which, so far as I can see, exist for the purpose of discussing resolutions. If so, it will be necessary for us to resolve ourselves into another Conference.

Dr. FARRAR proposed and Dr. STRONG seconded that the Conference should now adjourn.

The Conference then adjourned, but before separating listened informally to a paper by Dr. Wörster entitled *Rodents in Mongolia and Manchuria.* [This paper consisted of an enumeration of the different species of rodents encountered in Mongolia and Manchuria, with brief descriptions of the more common species.]

PART II

PREPARATION OF RESOLUTIONS AND SUMMARY OF EVIDENCE FOR THE INTERIM REPORT—CLOSING CEREMONY

SESSION XVIII, APRIL 24

PRELIMINARY BUSINESS

Dr. WU took the chair at 10.10 a. m.

The minutes of Session XVII were adopted.

Dr. ASPLAND drew attention to the fact that these minutes were headed "For private circulation only."

Dr. GRAY. I beg to propose that telegrams of thanks be sent to the Russian authorities at Harbin and also to the Chinese authorities at Fuchiatien for the extremely kind reception they gave us there. We had a most instructive and enjoyable time.

Dr. MARTINI seconded this proposal, which was carried by acclamation.

The CHAIRMAN. We should like to have the work of the committees finished before Tuesday evening, so as to present the resolutions to the full Conference on Wednesday and Thursday mornings, and reserve Friday for any special urgent business.

Dr. FARRAR said that the committee on D 3 had a series of resolutions ready, and the bulk of their resolutions would be submitted to the Secretary for circulation before 4 p. m. that day.

The Conference then adjourned until 10 a. m. next day.

[The various committees went into session immediately after the adjournment of the Conference.]

SESSION XIX, APRIL 25

PROGRAMME

I. Preliminary business.
II. Discussion and adoption of resolutions (Nos. 1 to 9, inclusive, of the Interim Report, see p. 390) on Section A, "Epidemiology:" "1. The origin of the past epidemic;" and "3. The relation of animal plague to the past epidemic." "a. Tarbagans."
III. Discussion and adoption of resolutions (Nos. 33–43, inclusive, of the Interim Report, see p. 396) on Section D 3, "Measures to be taken to prevent a widespread diffusion of infection."

PRELIMINARY BUSINESS

Dr. WU took the chair at 10 a. m.

The SECRETARY read the following telegrams:

"General Horwat, Harbin Central: The Delegates of the International Plague Conference and your guests wish to express their great appreciation of your kind hospitality and for all the arrangements made for a highly instructive and enjoyable excursion."

"Taotais Kuo, Tan, Yu, and Sung, Kirin Bureau, Harbin: The Delegates of the International Plague Conference and your guests wish to express their grateful thanks for your kind hospitality."

The minutes of Session XVIII were adopted.

DISCUSSION OF RESOLUTIONS ON SECTIONS A 1 AND 3 a[1]

The CHAIRMAN. The next subject for discussion is the resolutions on section A 1 and 3 a. Does the Conference wish these resolutions to be dealt with seriatim, or *en bloc?*

After some informal discussion Dr. FARRAR proposed and Dr. STRONG seconded that the resolutions should be passed *en bloc*, subject to editing.

Dr. STRONG stated that by editing he meant only grammatical changes.

On this understanding the resolutions were adopted unanimously.

DISCUSSION OF RESOLUTIONS ON SECTION D 3[2]

The CHAIRMAN. We pass now to the draft resolutions of the committee on D 3.

[1] These resolutions as proposed are found at the end of the proceedings of this session, page 346. As finally passed they will be found in the Interim Report, page 390, Nos. 1–9.

[2] These resolutions as proposed are found at the end of the proceedings of this session on page 347. As finally passed they will be found in the Interim Report, page 396, Nos. 33–43.

Dr. FARRAR. I propose that they be accepted *en bloc*. They were unanimously accepted by a committee of seven, and, therefore, I think there is nothing controversial in them.

Dr. MARTINI. I propose that to these resolutions should be added a recommendation that there should be an increase in the number of telegraph offices in the dangerous area, because at present there are too few, and the number ought to be increased.

Dr. FARRAR. We are going to have a further meeting of the committee after this session, and that point will be considered.

Dr. GRAY. Have you any information as to the number of telegraph stations that there are?

Dr. MARTINI. I do not think there are very many because we did not hear of this disease before it was in Manchuria, and everybody was surprised when it became known. Of course, you can make investigations and find out how many there are. It is very important to know that.

Dr. GRAY. I would like to be quite clear as to whether there are gaps in which there are no telegraph stations. I think that to a certain extent we must divorce the lack of news sent from the number of stations. You say that you did not hear from Manchuria, but that was because people were not sending news to you. What gaps were there in the telegraph system?

Dr. MARTINI. I do not know. It must be examined to see that we are not surprised in future.

Dr. GRAY. Were you not surprised because no one telegraphed through? The telegraph stations were there, were they not?

Dr. MARTINI. It must be examined to see whether there are sufficient stations. If there are not sufficient, more must be provided. It seems to me that we should have as many stations as possible in order to avoid surprise.

The CHAIRMAN. I believe that there are a number of telegraph stations in China at present.

Dr. MARTINI. This question must be considered, that is all.

The CHAIRMAN. I do not think we ought to add anything about the number of telegraph stations until we know how many there are. I know that so far as Manchuria is concerned there has been no difficulty in transmitting messages.

Dr. MARTINI. If the first case is known it is not so dangerous, because it can be isolated at once.

Dr. GRAY. During the recent epidemic there was scarcely a place that was not within telegraphic communication—that is, scarcely a place of importance.

Professor ZABOLOTNY. The report of the first case ought to be telegraphed at once to the headquarters of the different provinces, and arrangements should be made for the transmission of these telegrams in accordance with the Paris Convention.

The CHAIRMAN. As there seems to be considerable difference of opinion in regard to these resolutions, I will ask the Medical Secretary to read them so that they can be adopted one by one.

Dr. FARRAR. I think it would save time in the long run if we took these resolutions separately.

Resolution I [33][1] was then discussed.

[1] The numbers inclosed in brackets correspond to the numbers of the resolutions in the Interim Report on pages 390 to 391.

Dr. GRAY proposed that the words "and north China" should be inserted after "Manchuria."

Dr. CHRISTIE seconded this proposal, and with this amendment the resolution was carried.

RESOLUTION 2 [33]

The adoption of this resolution was proposed by Dr. FARRAR and seconded by Dr. MARTINI.

Dr. GRAY. I think it would be better to alter "joint railway board" to "joint railway medical board," or "sanitary board."

The CHAIRMAN. I wish to draw your attention to the fact that a sanitary board may not have any authority.

Dr. FARRAR. Any executive work must be done by the traffic managers. Doctors can not stop trains, etc.

Dr. GRAY. I do not think that the Chinese Eastern Railway or the South Manchuria Railway would allow anything to be done by a board on which the Chinese had a vote, just as the Imperial Railways would not hold up traffic or do anything that was recommended by a board upon which the Russians and Japanese had votes. The scheme will only go through if it provides for medical purposes. Something might be evolved later on out of the medical board. It is asking too much to pass the resolution in its present form, because these railways have important political considerations. It is not for us to cut the Gordian knot of their difficulties by linking up the management.

Dr. STRONG. What is proposed is something that is desirable, even if it can not be done at the present time.

Professor KITASATO seconded Dr. GRAY'S amendment.

Dr. STRONG. How can a medical board of this nature have any authority over railway quarantine? It would never be worth anything.

Dr. FARRAR. The different managers would meet and agree upon certain things. Surely that is constantly being done. This resolution does not involve any commercial or political interests.

Dr. ASPLAND. I would like to suggest to our friends who do not live in China that those who lived here would almost all take the view that Dr. Gray has taken. The traffic manager of a railway has just as much authority as you or I have. He is entirely controlled from the central office—from Peking if it be a Chinese railway. A medical board would give a tone of medical authority, whereas an administrative board would introduce complications.

Dr. FARRAR. A medical board has no power upon the railways.

Dr. STRONG. The idea of having a joint board is to connect with Peking.

Dr. ASPLAND. All the railways have their own medical officers.

Dr. FARRAR. The traffic is run by the traffic manager, not by the medical officers.

The CHAIRMAN. There seems to be considerable difficulty about the question of the railway board and the medical board. Perhaps it would be better to leave out the words "railway" and "medical" and simply call it a "joint board."

Dr. FARRAR. A joint board on the railway would be a railway board.

The CHAIRMAN. Dr. GRAY proposes and Professor KITASATO seconds that we use the words "joint railway medical board."

Dr. FARRAR. I propose the words "joint board." Cut out the word "railway" and make it "joint board."

Dr. STRONG. I second that.

Professor ZABOLOTNY. As this whole paragraph is connected with railways, the word "railway" must stand.

Dr. CHRISTIE. "Railway" appears lower in the resolution.

Dr. ASPLAND. How would it smooth over the difficulty to call it a "joint medical and railway board?"

Dr. GRAY asked that his amendment should be voted upon.

Professor KITASATO also wished the amendment proposed by Dr. Gray to stand.

Dr. FARRAR'S amendment, seconded by Dr. STRONG, was then put to the meeting and lost by 6 to 4 votes.

Dr. GRAY'S amendment was then put to the meeting and was also lost.

Dr. BROQUET proposed as an amendment that the words used should be "joint railway and medical board," and this was put to the meeting and carried, six votes being recorded in favor of it, while the remaining delegations abstained.

Dr. ASPLAND. I am afraid that if it appears as it is proposed now, the railway companies will get rather agitated. I suggest now, in relation to No. 2, that as instructions were only given to the Conference in regard to plague the words "or other diseases" be deleted.

Dr. CHRISTIE. I second that. I think it is a very wise suggestion. We are not asked to deal with other diseases.

Dr. STRONG. These recommendations would apply equally to cholera.

Dr. ASPLAND. We are not asked to frame resolutions in relation to cholera, but only in regard to plague.

Dr. STRONG. It is a very good thing to improve sanitary conditions in general. If you have a big epidemic of cholera these measures would be just as important as when dealing with plague.

The CHAIRMAN. I will now put this before the Conference. It is proposed by Dr. Aspland and seconded by Dr. Christie that the words "or other diseases" be omitted. I may remind the Conference that we met here to make recommendations with regard to pneumonic plague. I now put Dr. Aspland's motion to the meeting.

The motion was lost, only China and Great Britain voting in favor.

Resolution 2 [33], as finally passed, therefore read:

"With this object we recommend that a joint railway and medical board for quarantine and sanitary purposes only, having a central office, should be formed by the railway companies concerned to frame regulations for the control of traffic in times of epidemic prevalence of plague or other diseases."

Dr. CHRISTIE. I think that the quarantine regulations are not sufficiently stated here. Something very definite is required in dealing with quarantine. I therefore move that between resolutions 2 [33] and 3 [34] we insert:

"When plague assumes epidemic proportions in any city or defined area, no traveler shall be allowed to leave an infected district, whether by rail, road, or water, without undergoing five days' quarantine."

Dr. FARRAR. I beg to propose that we should not go into this matter in too great detail. The whole question of quarantine is covered by resolution 12, and I think we may leave the details to be included in the Plague Code.

Dr. CHRISTIE. I think we should give details of an important matter

like quarantine. In these recommendations there is nothing definite at all about carrying out quarantine. I do not think it is wise to leave a question like quarantine; all the details ought to be stated.

The CHAIRMAN. We are not getting on very fast. As there were seven gentlemen on this committee, it seems to me that there ought to be a spokesman on behalf of the committee. The committee itself appears to be divided in regard to these resolutions.

Dr. STRONG. It seems to me that the committee does not agree.

Dr. CHRISTIE. I think our committee would be quite agreeable to this addition.

Dr. STRONG. Is the restriction of travelers to apply to first-, second-, and third-class passengers alike?

Dr. CHRISTIE. Yes.

Dr. STRONG. I think that is too much.

Dr. CHRISTIE. I am quite willing that it should be limited to coolie travelers.

Professor ZABOLOTNY. I think the best course would be to adopt the rules and regulations for quarantine laid down in the Paris Convention. I think it is unnecessary to insert special rules here. It will take up too much time.

Resolutions 3 and 4 [34] and 5 [35] were adopted *nem. con.*

RESOLUTION 6 [36]

Dr. FARRAR explained that the object of this resolution was to prevent coolies from being harried so much that they would try to travel by road instead of by rail.

Dr. MARTINI proposed and Professor ZABOLOTNY seconded the adoption of this resolution.

Dr. STRONG. I think it would make it clearer if it were altered to "traveling coolies to journey by."

Dr. FARRAR proposed and Dr. STRONG seconded the adoption of the resolution with this alteration.

It was carried *nem. con.*

RESOLUTION 7 [37]

This resolution with the substitution proposed by Dr. Christie of the words "sanitary passes" for "health certificates" and the substitution of "supervision" for "surveillance" was carried *nem. con.*

RESOLUTION 8 AND 9 [38]

Dr. GRAY asked if the Chairman could give him the mileage of the coast line of the Gulf of Pechihli and the number of coast guards who would be required to the mile.

The CHAIRMAN. I fear that we may be recommending too much.

Dr. STRONG proposed the substitution of the word "supervision" for "surveillance," and that the words "there should be * * * seaboard of the Gulf" should be deleted.

Dr. CHRISTIE proposed that resolutions 8 and 9 in the draft resolutions should be combined to form one resolution, Dr. STRONG'S amendments being adopted, and the words "and that" inserted between the two resolutions. He further suggested that the words "by the Imperial maritime customs" should be omitted.

Dr. GRAY said that the supervision of traffic upon rivers was the one business that came under the control of the Imperial maritime customs.

Dr. CHRISTIE asked Dr. Gray if he thought that the customs would carry out these regulations. He did not think the resolution as it stood would be of any effect at all. He considered that it was unnecessary to refer to the customs.

Dr. GRAY said that on the big rivers—the Amur, for instance—the Imperial maritime customs had barges.

Dr. CHRISTIE. Do you know how they control the traffic on rivers? They do not extend their authority to the slightest degree upon these inland rivers.

Dr. PETRIE. I understand that the rivers are frozen during the time of pneumonic plague.

Dr. CHRISTIE. I advise you to leave the reference to the customs out.

Dr. BROQUET said that he thought draft resolution 9 was unnecessary.

Dr. CHRISTIE said that he desired to include supervision of traffic upon rivers but wished the last five words of the resolution to be omitted.

Resolution 8 and 9 [38] was finally adopted *nem. con.* in the following form:

"In view of the fact that coolies and other travelers are known to land from junks and open boats along the coast line other than the recognized ports, there should be closer sanitary supervision than heretofore of the coast line of the Gulf of Pechihli in time of plague, and that there should also be sanitary supervision of traffic on rivers."

RESOLUTION 10 [39]

Dr. STRONG. Why are hides included in No. 10?

Dr. FARRAR. There seems to be some objection to including the word "hides" in this resolution, and several of the committee are willing to accept an amendment "grain or other cargoes likely to attract rats."

With this amendment the resolution was carried *nem. con.*

RESOLUTION 11 [40]

Dr. STRONG proposed that the words "or of coffins" should be omitted. The resolution was intended to apply to corpses alone.

Professor ZABOLOTNY thought that a resolution in regard to the throwing out of corpses ought to be included.

The CHAIRMAN pointed out that although they might wish to prevent the throwing out of corpses it was often impossible to find who had done so. In any event, another committee was dealing with the subject of corpses.

With the amendment proposed by Dr. STRONG this resolution was adopted *nem. con.*

RESOLUTION 12 [41]

Dr. FARRAR. This resolution is based upon the Famine Committee of India. We do not want to wait until plague comes and then frame regulations. When famine breaks out in India, the moment it is declared, every official knows exactly what he has to do. Everything is in readiness beforehand. If a plague code were drawn up, thousands of valuable lives might be saved because every official would then know exactly what his duties were.

Dr. BROQUET suggested that the code ought to be in accordance with international rules.

Dr. FARRAR. The International Convention of Paris simply deals with international traffic. The Plague Code should contain instructions to every official in the Empire.

Dr. CHRISTIE. I quite sympathize with Dr. Farrar's resolution, but the question arises, Who is to draw up this code? Are we not here for that very purpose? It would be a very large order for the Chinese Government to draw up the code.

Dr. STRONG. Who is going to draw it up? Whom do you suggest?

Dr. FARRAR. The Government must appoint someone to draw it up.

The resolution was then put to the meeting and adopted *nem. con.*

Resolutions 13 [42] and 14 [43] were also adopted *nem. con.*

Professor ZABOLOTNY suggested that it was desirable to add another rule to the following effect:

"The first cases of plague must at once be communicated to the neighboring Chinese authorities and to the neighboring powers of Russia and Japan."

Dr. FARRAR. This committee is meeting again to-day, and that point will be considered. Our resolutions are not complete yet.

The Conference then adjourned until the following day.

DRAFT RESOLUTIONS OF COMMITTEE ON SECTIONS A 1 AND 3 a

[Members: Drs. Zabolotny, Kitasato, Strong, Ch'uan, and Gray.]

1. The committee finds that the past epidemic originated in a region which has been associated for years with outbreaks of pneumonic and bubonic plague, but sufficient evidence is not forthcoming with regard to the precise origin of the epidemic.

2. From Russian medical sources it has been reported that an epizoötic disease exists among tarbagans and that it is not unlikely this disease is plague, but that it really is plague has never yet been proved bacteriologically.

3. There is no definite evidence to show that the first cases of this epidemic were caused by infection from sick tarbagans.

4. Nevertheless, there is a strong presumption for believing that tarbagan disease is closely associated with pneumonic plague in Manchuria, trans-Baikalia, and northeast Mongolia, and, therefore, with the recent outbreak.

5. Consequently, we recommend that systematic investigations be carried on as to whether epizoötic disease occurs among the rodents (tarbagan included), and, if such exists, that an accurate investigation be made of the nature of infection.

6. Such investigations should be made under the direction of someone who has had special experience in the examination of rodents for plague infection, and the investigation should consist of the complete anatomical and bacteriological examination of these animals with the careful identification of any organisms encountered.

7. Provision should be made for discovering cases of sickness among the rodents and bringing them to the quick notice of the investigators.

8. The committee suggests that the two countries principally interested (Russia and China) should separately assume the responsibility for carrying out such investigations.

9. It also recommends that arrangements be made for bringing the tarbagan-trapping community in Manchuria district under a system of medical surveillance, particularly during the trapping season, and that

a segregation hospital should be established at the headquarters of this community.

10. Further, it recommends that the question of infection of mules, donkeys, and dogs be made the subject of special study with regard to their liability to infection. Although instances have been reported, the subject needs further study.

DRAFT RESOLUTIONS OF COMMITTEE ON SECTION D 3

[Members: Drs. Gray, Farrar, Christie, Hehewerth, Galeotti, Zabolotny, and Kitasato.]

1. That concerted action between the different railway companies of Manchuria should be promoted, so as to bring about a uniform system of sanitary defense on all railway lines.

2. With this object we recommend that a joint railway board, for quarantine and sanitary purposes only, having a central office, should be formed by the railway companies concerned, to frame regulations for the control of traffic in times of epidemic prevalence of plague or other diseases.

3. There is evidence before the Conference of want of uniformity in the action of different port authorities in respect of quarantine measures, and there are grounds for believing that in some instances the stringency or otherwise of quarantine measures in ports is left to the individual initiative of medical officers in different ports.

4. We recommend that, so far as may be practicable, a uniform international system of port sanitary administration and quarantine for north China should be brought about by coöperation between the Imperial Government of China and the other nations concerned. Such administration should follow the lines, so far as they are applicable, of the Convention of Paris, 1903.

5. With a view to systematizing, in epidemic periods, the control of traffic both by land and sea, the above-named joint railway board should so far as may be practicable act in concert with the above-named international port sanitary service.

6. To facilitate the control of coolie traffic by land and sea, inducements should be offered to coolies to travel by rail and by recognized steamer lines, and the regulations devised should be such as to combine the maximum of efficacy in respect of controlling the spread of disease with the minimum of restriction of travel.

7. In times of epidemic prevalence of plague there should be surveillance of travelers by road and of cart traffic by the magistrates and officials of towns and villages in the affected districts, together with inspection and surveillance of inns, poorhouses, etc. Travelers by road should be furnished with health certificates, which should require to be viséd at the yamens of the places through which they pass.

8. In view of the fact that coolies and other travelers are known to land from junks and open boats at points along the coast other than the recognized ports, there should be closer surveillance than heretofore of the coast line of the Gulf of Pechihli, and in time of plague there should be a coast-guard service for the whole seaboard of the gulf.

9. There should also be surveillance of traffic on rivers by the Imperial maritime customs.

10. The evidence before us is to the effect that it is unnecessary and undesirable in respect of pneumonic plague to restrict the transit of goods (other than personal luggage) and of mails.

Should there be evidence at any subsequent time of rat epizoötic, it

would become necessary to take measures to secure the destruction of rats on ships and in ports and to guard against the passage of rats from shore to ships or from ships to shore. In this event it might also become necessary to frame special regulations in respect of cargoes containing grain or hides. Such regulations should follow the lines, so far as they are applicable, of the Convention of Paris, 1903.

11. In time of plague the carriage or shipment of corpses or of coffins should be prohibited.

12. A plague code should be forthwith drawn up by the Imperial Government embodying complete regulations and instructions to all officials concerned applicable on the outbreak of plague.

13. A permanent nuclear sanitary organization should be formed, capable of rapid expansion in time of plague, and a list should be drawn up of medical officers who could be immediately sent to the affected area on the outbreak of plague.

14. Means should be devised to instruct the public that plague regulations are made in the public interest and for the protection of the whole people.

SESSION XX, APRIL 26

PROGRAMME

I. Amendment to resolution 33 of the Interim Report, see page 396.
II. Discussion of resolution on Section D 3 (continued).
III. Discussion and adoption of resolutions (Nos. 22–24 of the Interim Report, see p. 393) on Section D 2, "Measures to be taken to limit the spread of infection in an infected town or village."
  h. Methods of removal and disposal of plague corpses.
  i. Organization of the sanitary staff.
  j. Precautionary measures to be taken by those attending on the sick, etc.
IV. Adoption of provisional conclusions of the editorial committee for the Interim Report, see page 388.

Dr. WU took the chair at 10 a. m.

AMENDMENT TO RESOLUTION [33][1]

Dr. STRONG. I should like to make a motion with regard to the words "joint railway and medical board," in Section D 3 resolution 2 [33]. I believe that we are all agreed that it should read "joint railway medical board." I think that we all agreed to this after the meeting yesterday.

Dr. MARTINI seconded this amendment.

The CHAIRMAN. With this modification I ask you to pass the minutes of Session XIX.

Dr. FARRAR. I think it should read then "to advise as to regulations for the control of traffic." The joint railway medical board can not frame regulations, but can advise as to regulations. I think it should be worded "to advise as to regulations for the control of traffic." I therefore move that the words "advise as to" should be substituted for "frame." We do not want to stultify ourselves.

Dr. GRAY. Or the board. There is a difference between framing regulations and enforcing them. We do not say that the board is to enforce the regulations.

The CHAIRMAN. Is Dr. Farrar's amendment seconded?

On the proposition of Dr. MARTINI, seconded by Professor ZABOLOTNY, the minutes of the previous session and the resolutions of the committees upon D 3 and A 1 and 3 a were adopted with the amendment to omit the word "and" between "railway" and "medical".

DISCUSSION OF RESOLUTION ON SECTION D 3 (continued)

The CHAIRMAN. We will now pass on to the further resolutions of the committee on D 3.

Dr. FARRAR. These resolutions were adopted by the committee on D 3, but events subsequently transpired which seemed to indicate that it might

[1] Figures in brackets indicate the number of the resolution in the Interim Report.

probably be impolitic to pass resolutions containing such detail. Personally I should like to fight to the death for these resolutions. Possibly if we were to substitute a simpler and shorter resolution to this effect, it might meet the difficulty which seems to have arisen outside the committee.

13. "With a view to prompt dealing with future epidemics that may occur, we recommend that provisions be made for immediate notification of the outbreak of plague to a central head office." No. 18 would then become No. 14, and remain as it stands.

Professor KITASATO complained that the committee had not been consulted in regard to the proposed alteration.

Dr. FARRAR. I was called upon by others to speak about this point, though I was very anxious not to take any part in it. I was very anxious that someone should get up and propose these resolutions *en bloc*. That was what the committee recommended. As I was called upon to do so, I suggested what seemed to be the opinion of the majority of the Delegates. As the matter was only talked over between 12 and 1 last night it was impossible to consult everyone on the subject, but I consulted everyone I had an opportunity of seeing.

The CHAIRMAN. As there seems to be some difference of opinion among the committee, I propose that the further resolutions on D 3 should be held over until this afternoon, so that the committee may have an opportunity of meeting and talking the matter over.

Dr. FARRAR. Why not bring up what we have on the paper? Bring up for discussion the resolutions that have been circulated. I do not see why the matter should not be discussed now. I can then substitute what I have proposed at a later time. Bring up what is on the paper, and discuss it.

Dr. ASPLAND. As it will be necessary to have another afternoon session, I should like to suggest that the committee on D 3 meet again between the sessions and bring up these further resolutions again this afternoon. That would save a lot of time now, if it is agreeable.

The CHAIRMAN. If that is agreeable to the Delegates, I suggest that we pass on to the draft resolutions of the committee on D 2 h to j. Is it the desire of the Conference that they should be read one by one?

DISCUSSION OF RESOLUTIONS ON SECTIONS D 2 h TO j[1]

The Chairman then put the first paragraph of the resolutions on D 2 h [22] to the meeting.

This was adopted without comment.

The second paragraph was then read.

Dr. FARRAR. I venture to suggest that it is necessary that the word "blunt" should be inserted before the words "iron hooks."

Professor ZABOLOTNY said that he desired to include in these resolutions the importance not only of removing and disposing of corpses, but of discovery previous to their removal.

The CHAIRMAN. That comes under another section.

Dr. GRAY. I beg to move that the resolutions on h be passed with the addition of the word "blunt."

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[1] These resolutions as proposed will be found at the end of the proceedings of this session on page 360; as finally passed they will be found in the Interim Report, page 393, Nos. 22–24.

This was seconded by Professor GALEOTTI, and all the resolutions on h were then passed.

The resolutions on subsections i and j were then placed before the meeting for discussion.

Dr. FARRAR suggested the addition of the word "sanitary" in the second paragraph, between "system of" and "administration."

Dr. STRONG. I move that we strike out the sentence providing that the sanitary staff shall be inoculated with plague vaccine. Until we have more definite evidence of the protection of vaccination in pneumonic plague I do not think we should make such a recommendation. Moreover, this ground has been covered by the committee on prophylactics and vaccines.

Dr. PETRIE. The resolutions of the vaccine committee seem to suggest that this might stand.

Dr. STRONG. The committee recommended experiments with animals to see whether vaccines would protect them against pneumonic plague. If this resolution went in as it stands it might give a sense of false security to the sanitary staff. The members of it would think that they were protected by inoculation and might then become careless, and thus vaccination would give them a sense of false security. As a matter of fact, a great deal of the evidence given here regarding the recent epidemic is that vaccines were not protective.

Dr. FARRAR. These resolutions go on to lay stress upon the wearing of masks.

Dr. GRAY. If it is practicable I should like to see this go through, if for no other reason than that the sanitary staff will be more under the doctors' eyes, and the doctors should be able to give us data regarding the value of inoculation which we should not be able to get from any other body of men during an epidemic.

Dr. STRONG. Then I will withdraw my motion.

Dr. PETRIE. I want to know what was in the minds of the committee when it suggested that quarters of the sanitary staff should be isolated as far as possible.

Dr. FARRAR. It was not meant that the sanitary staff should be kept in an isolated spot, but that the members should be effectively isolated so as to prevent them going hither and thither in town when off duty, and possibly carrying infection with them. I think the staff ought to work in isolation from the rest of the community, and that, therefore, its quarters should be isolated.

Dr. STRONG. I should like to explain that I withdraw from my position with regard to the inoculation of the sanitary staff and that I should like to add, as Dr. Gray has suggested, "for the purpose of obtaining statistics of the value of inoculation," or "so as to obtain further information with regard to the value of inoculation."

Dr. FARRAR. I think that that would give the impression to the members of the sanitary staff that they were under an experiment.

Dr. STRONG. That is what it actually is. I would like to have what I have suggested included in the resolutions.

Dr. CHRISTIE. I think that the suggestion that vaccination would give a false sense of security might be said to apply to everyone. As regards Dr. Gray's suggestion, I am afraid that the sanitary staff might object to being made martyrs to science. I feel sure the members would object to that.

Dr. STRONG. I do not think that we should attempt as a Conference to deceive the members of the sanitary staff with regard to the protective value of inoculation in pneumonic plague. If they are going to be inoculated to obtain more accurate statistics, we might say so. If we think it is going to protect them, that is another matter. But we have no evidence in regard to that, and do not know whether it does protect. It has been suggested by the committee on vaccines and prophylactics that further experiments should be made upon animals. Until these experiments have been made I think we should be doing wrong to make this recommendation.

Dr. FARRAR. The resolutions of the vaccine committee stated that there were strong grounds for believing that a certain degree of protection was conferred by vaccines against bubonic plague. We have not stated that they confer complete protection, but surely we are all of the opinion that they confer some degree of protection.

The CHAIRMAN. You should read the whole of the first resolution on vaccines.

Dr. FARRAR. The resolution reads: "The statistical evidence points to the conclusion that some degree of protection is conferred against bubonic plague by the use of vaccines." We then go on to say: "Therefore, there are *a priori* grounds for the use of inoculation with vaccines as a means of protection against pneumonic plague."

Dr. STRONG. Now read the last paragraph.

Dr. FARRAR. Yes. It reads: "We offer the following advice: (*a*) That experiments on animals (guinea pigs, white rats, and monkeys) should be carried on by the method of inhalation, in order to find out which vaccine can best be used against pneumonic plague. (*b*) That should another outbreak of pneumonic plague occur the above methods of vaccination should be tried in selected communities (as in India) under rigorous scientific conditions."

That is not in the least a contradiction of the first two resolutions.

Professor GALEOTTI. It is no ground at all for saying that we should not recommend the vaccination of the sanitary staffs.

Dr. STRONG. Why give a sense of false security?

Dr. GRAY. We go on to say that the staff should be provided with masks.

Professor GALEOTTI. For my part, I should certainly inoculate myself in any case before coming into contact.

Dr. STRONG. My original motion was to strike this resolution out, as the matter is already covered by the resolutions of the vaccine committee. I think this is a dangerous resolution to pass here, so far as the sanitary staffs are concerned. There are many uneducated men on them. These men will rely upon the advice given to them by the Conference and may depend too much upon the protection from vaccination.

Dr. FARRAR. We have told them that vaccines confer some degree of protection.

Dr. FARRAR. I propose that the whole of the resolutions on subsection i be passed.

Dr. ASPLAND. I should like to suggest that as a rule of procedure no one should speak upon a resolution or amendment unless it is seconded. It is very difficult indeed for the stenographer to take notes if no one addresses the chair, and everyone is engaged in speaking across the table. He can not hear half of what is going on.

Dr. CHRISTIE. I think we should get over the difficulty raised by Dr. Strong if we added "until further statistics are available."

Dr. STRONG. I second that.

Professor GALEOTTI. The meaning of this amendment is that we expect a negative result from the statistics. That is not right. I suggest as another amendment that the Conference should point out that one can not rely entirely upon inoculation.

Dr. ASPLAND. That is already done in the resolutions on vaccines.

Professor GALEOTTI. It could also be included here. I suggest that we add that the Conference wants to point out that inoculation can not be relied upon entirely.

Dr. CHRISTIE. I suggest that instead of the amendment I proposed, we add the words "unless further investigation shows that such vaccination does not protect against pneumonic plague."

Dr. STRONG. I can not accept that.

Dr. FARRAR. I should like to point out that we are not discussing a scientific point. We are discussing administrative regulations which depend upon scientific points already discussed and decided upon elsewhere. As the outcome of what the scientific committee told us, we have made a practical administrative recommendation. We give a practical administrative recommendation in accordance with the guidance of those experts. At this stage we can not go over the scientific work done on another occasion. We say, therefore, that we should give the sanitary staff whatever degree of protection vaccines may confer.

Dr. STRONG. And make them lean on that.

The CHAIRMAN. I should like to draw your attention to the evidence brought forward by the Chinese and Russian workers at Harbin. So far as I can gather our united experience has been decidedly contrary to expectations. If so I believe it is our duty not to lead men unversed in pneumonic plague astray. We should guard against recommending the use of vaccines which have not proved as satisfactory as might be wished.

Dr. STRONG. I think a vote should be taken upon Dr. Christie's original amendment to add the words "until further statistics are available."

Dr. CHRISTIE. I suggest that these words should be put before the resolution, and that it should read "until further statistics are available we recommend, etc."

The amendment was then put to the meeting and lost, only two delegations voting in favor of it.

Dr. STRONG. I ask that a minority report be recorded on this discussion.

The CHAIRMAN agreed, but after some further informal discussion the amendment proposed by Dr. CHRISTIE and seconded by Dr. STRONG was again put to the meeting, and this time was carried [24].

Dr. GRAY. With regard to the first paragraph in these resolutions, I can not at the moment say how many *hsien*[1] there are, but there must be a good many hundreds of thousands throughout China. Does this resolution call for ten or twelve thousand medical and sanitary staffs to come into existence at once? If it is passed, about 100,000 doctors would be required and 400,000 to 500,000 members of the sanitary staff. If the staff is to be capable of rapid expansion that would mean that nearly a million doctors and men would be required. Should we not modify that and limit it to each district in which pneumonic plague is dealt with in

[1] City of the third rank.—[EDITOR.]

Manchuria and north China. To have doctors in central China, south China, and west China as well would make it a tremendous question. I therefore move that it should be modified.

Dr. FARRAR. One doctor might form the nuclear sanitary and medical staff for several *hsien*. We were guided in this committee by a gentleman who had an intimate knowledge of China, and suggested the use of the word *hsien*.

Dr. CHRISTIE. This point seems to be largely covered by a recommendation from another committee. I quite agree with Dr. Gray that it can not be left in its present form. I do not think the committee can really have understood what a *hsien* really means in China. That must be altered. It might stand if limited to the districts where plague has already broken out, but if applied to the whole of China it would mean a much larger medical staff than it would be possible to provide. I think the whole matter is largely covered already in the resolutions on D 3.

Dr. GRAY. It seems to me to be covered by D 3 also.

Dr. CHRISTIE. I think it might be allowed to stand over.

Dr. GRAY. I propose that it be deleted in favor of the resolutions in D 3.

Dr. CHRISTIE. D 3 13 [42] reads: "A permanent nuclear sanitary organization should be formed, capable of rapid expansion in time of plague, and a list should be drawn up of medical officers who could be immediately sent to the affected area on the outbreak of plague." I think that covers it.

Dr. FARRAR. One refers to the spread of the epidemic in an infected town or village and the other refers to the wide diffusion of the epidemic. We are bound to give advice that will to a certain extent overlap. But these two points were carefully differentiated by the committee that so ably drew up the programme. I think we are justified in following the programme.

Dr. GRAY. I propose that this paragraph be deleted.

Dr. CHRISTIE. I second that.

The CHAIRMAN. I place Dr. Gray's motion before the meeting.

Dr. GRAY. I do not think the Conference quite understands what we are supposed to be voting upon. There are tracts in China over twice the size of England which have not a modern doctor in them, and we propose to people them with doctors and sanitary forces. I think that is really absurd. We are really dealing with Manchuria and north China, but when we come to central and west China there are tremendous tracts of thousands of square miles where such a thing as a Western doctor is unknown. When the members of the Waiwupu read such a resolution as this they will say that we know nothing about the matter.

Dr. CHRISTIE. In presenting our resolutions to the Chinese Government we should be within the limits of possibility. If we go beyond those limits we run the risk of having all our recommendations set aside. This proposal is quite impossible. It would be impossible to carry out such a recommendation, and I think it is already sufficiently covered by the resolutions on D 3. I believe that it would shake the Government's confidence in our judgment if we were to pass this.

Professor ZABOLOTNY. In western and other countries each *hsien*, so to speak, has several doctors. Why should not the same thing be possible in China? We do not mean that it shall be done at once, and we have put no time limit to it. But it is quite feasible to carry out such a scheme eventually.

Dr. HAFFKINE says that in Russia there are about 22,000 doctors. It is quite possible to have as many in China.

The CHAIRMAN. We are only discussing what is to be done in China.

Professor ZABOLOTNY. It is only a question of time before it can be done.

Dr. GRAY. The Conference should remember that there is a different system in China. There are great numbers of people who are willing to stick to the empirical system of medicine of their forefathers, and who are not going to accept a Western doctor even when one is foisted upon them. If provisions were made for notification of deaths and the gradual installation of this system that would be one thing, but to talk about a permanent nuclear system in each *hsien* leaves the Government with a recommendation which it is impossible to carry out.

Dr. FARRAR. Surely we should point out that plague has assumed widespread proportions because of lack of preparation, and in dealing with our recommendations we should pass resolutions which conform to our ideas of what is necessary. If the medical profession in China is not sufficient, the Government should make it so as soon as possible for the benefit of all concerned.

Dr. GRAY. I refuse to admit that plague has assumed widespread proportions. Manchuria has a population of about twenty millions, and there are fifty to sixty millions of people in Shantung and Chihli. Forty thousand deaths among so many is not very much. In India more than that die of bubonic plague in a month.

Dr. ASPLAND. His Excellency Alfred Sze laid great stress upon the fact that our suggestions should be practicable. When I first saw this recommendation I was greatly surprised. It would be absolutely impossible to carry it out for generations to come.

Dr. GRAY. If the Conference will be guided by some of the doctors who know the country and its possibilities from an administrative point of view it would be better. I hope the Conference will pay attention to their words.

Professor ZABOLOTNY. The only practical way to discover plague is by an increase of the medical staff in China.

The CHAIRMAN. I feel very disinclined to take a partial view of any matter before the Conference. In this question I feel that it is very necessary for our friends the Delegates of the different countries to take notice of the words of some of the men who have lived here for a long time, because after all we wish to do the very best possible for the Chinese Government and in order to do that, our recommendations must be practicable. If we go beyond what is practicable, we are liable to make unnecessary recommendations. If we recommend something which is not practicable, perhaps other recommendations which are practicable may not redound to our credit. We seem to have come to a deadlock. Perhaps, if I might make a suggestion, we might refer this to the united committees on D 2 so that their recommendations may not overlap each other.

Dr. STRONG. Why not just suggest the organization of a sanitary staff and strike out the rest. We might leave the details to China to carry out.

Dr. FARRAR. I suggest that we could not get further in committee than here. I am quite willing to sacrifice my feelings and leave the vote to the majority of the British delegation.

Dr. ASPLAND. If that is generally understood, I think the first paragraph will meet Dr. Strong's recommendation.

The CHAIRMAN. I put the amendment that this paragraph be deleted, that the first paragraph of three lines be omitted.[1]

The amendment was lost by six votes to four.

Dr. GRAY. Where are the Delegates who stand by this going to get the doctors from? Is China to send for a shipload of doctors from Europe? I beg to enter my protest against this.

Dr. ASPLAND. The motion to delete this paragraph is lost. I think we might leave out the word *hsien* and the recommendation will then leave it open to the Chinese to do what they like.

Dr. MARTINI seconded this proposal.

The amendment that the word *hsien* be omitted was then put to the meeting and carried *nem. con.*

Professor ZABOLOTNY. The resolution never said how many doctors were required, but only a sanitary staff.

Dr. WORELL. Goggles are not mentioned here. They are very important, and ought to be considered.

Dr. FARRAR. That question was considered.

Professor GALEOTTI. I second Dr. Worell's motion to include goggles.

The CHAIRMAN. Do you mean for the coolies?

Dr. WORELL. For the sanitary staff in immediate contact with the patients. I think they should wear goggles.

Dr. FARRAR. Is the second paragraph passed? I propose that we accept the second paragraph of i, with the addition of the word "sanitary."

The second and third paragraphs, proposed by Dr. FARRAR and seconded by Dr. MARTINI, were adopted *nem. con.*

The first and second paragraphs of j were also adopted without discussion on the motion of Dr. FARRAR, seconded by Dr. MARTINI.

In regard to the next paragraph, Dr. GRAY brought forward an amendment to omit the word "economical."

The CHAIRMAN. The most practical is not always the most economical.

Dr. GRAY. Have you the figures for the amount spent upon gauze at Harbin?

Dr. FARRAR. I propose that we should leave out the word "economical." Simply leave in the word "best" (on all grounds).

Dr. BROQUET. This type of mask does not protect the whole face. I think a mask should be adopted that protects the whole face.

Dr. FARRAR. The three-tailed gauze bandage might not be the best for nurses and doctors, but we are talking about the sanitary staff. It is recommended for the sanitary staff.

Dr. STRONG. Are there no doctors on the sanitary staff?

Dr. PETRIE. These gauze pads would not be effective without plugs. Would it not be better to insert "with suitable plugs?"

Dr. ASPLAND. "Gauze and wool mask" would be quite enough.

Dr. GRAY. Or "with ala-nasal plugs."

Dr. FARRAR. "Reinforced by cotton-wool plugging."

Dr. ASPLAND. I think if we said "gauze and cotton-wool pad" it would

[1] This paragraph read as follows: "There should be in each administrative district (*hsien*) a permanent nuclear medical and sanitary staff capable of rapid expansion, ready for dealing with any outbreak of plague that may occur."—[EDITOR.]

suffice. Everyone who had to wear a mask would be instructed how to use it.

Dr. MARTINI. I second that.

Professor SHIBAYAMA. It is not necessary to destroy the masks after each tour of duty. They might be disinfected. I propose that the words "or disinfected" be added.

Dr. GRAY. I second that.

The amendments proposed by Dr. ASPLAND and Professor SHIBAYAMA, respectively, were then put to the meeting and adopted with only two dissentients, France and Mexico.

Dr. FARRAR. With regard to the fourth paragraph, the committee did discuss the question of goggles and decided not to recommend them. Personally, I think that they might be recommended. They are fairly cheap.

The CHAIRMAN. I understand that Dr. Worell desires to add the words "those in immediate contact with the patients should wear goggles in addition to the above."

Dr. FARRAR. The committee will accept that amendment.

The amendment was then put to the meeting and adopted *nem. con.*

The CHAIRMAN. The fifth paragraph is now before the meeting.

Dr. GRAY. I propose the words "sanitary station" instead of "headquarters."

This was carried *nem. con.*

The CHAIRMAN. Has anyone anything to say about the sixth paragraph?

Professor ZABOLOTNY. The only way to discover infection as early as possible is to take the temperature.

Dr. FARRAR. That point was also discussed. But in the sanitary staff there might be several hundred coolies, and I think the idea was that a doctor would be supposed to use his own discretion whether he used a thermometer or not.

Dr. ASPLAND. I think that Professor Zabolotny's recommendation is covered by that of the editorial committee.

Professor ZABOLOTNY. I think that the temperature of the sanitary staff ought to be taken twice a day.

Professor KITASATO seconded this proposal as an amendment to the resolution under discussion.

The CHAIRMAN. The amendment is to add to the resolution as it stands "and their temperatures taken twice daily," omitting the words "each day."

Professor ZABOLOTNY. The only secure means of discovering the disease is by taking the temperature. Other means do not enable us to decide positively whether a man is sick or not.

Professor ZABOLOTNY'S amendment was carried *nem. con.*

DISCUSSION OF PROVISIONAL CONCLUSIONS OF INTERIM REPORT.

The Conference then proceeded to consider the "draft summary of the provisional conclusions of the editorial committee."[1]

The CHAIRMAN. In regard to No. 1, which was dealt with under sections A 1 to 3 of the programme, Dr. IASIENSKI read a paper in the course of which he said that the disease had traveled from Siberia.

Dr. FARRAR. It is surely clear that its origin so far as we are concerned was northern Mongolia, whatever its primary origin may have been. These are simply provisional conclusions.

[1] These *conclusions* as proposed are found at the close of the session on page 360; as finally adopted they will be found in the Interim Report, page 388.

Dr. CHRISTIE. Was the editorial committee really satisfied from the evidence that the plague came from northern Mongolia?

Dr. PETRIE. As far as the epidemic in China is concerned is it not quite right as it stands? It may be traceable long ago to the Volga, but so far as we are concerned I think this statement is correct. We say "whatever may have been its primary origin."

Dr. CHRISTIE. I suggest that the words "from its origin in northern Mongolia" should be left out.

Dr. STRONG. I think the evidence showed that it came from northern Mongolia.

Dr. FARRAR. There is a distinction between its origin and its primary origin.

Dr. STRONG. The only evidence presented stated that the origin was in northern Mongolia. We could not express our own ideas about this matter. It is not a resolution, but a conclusion from the evidence submitted to the Conference.

Dr. CHRISTIE. Is the evidence sufficiently complete to enable you to say that?

Dr. STRONG. This is a summary of the evidence.

Dr. CHRISTIE. You clearly imply that the epidemic originated in northern Mongolia.

Dr. STRONG. That is what the evidence submitted implies.

Dr. BROQUET. Why not say simply "from northern Mongolia?"

With this modification, suggested by Dr. BROQUET, No. 1 was passed.

The CHAIRMAN. No. 2 is now before the meeting.

Professor GALEOTTI. I have an amendment to propose in the following words:

"The preventive measures which were enforced either in accordance with scientific methods or by the crude efforts of the people to protect themselves have acted favorably upon the decline of the epidemic, but climatic influences have also contributed directly or indirectly toward bringing the epidemic to an end, although the ways of these climatic influences are quite unknown.

Dr. PETRIE. Why not alter it simply to "a factor?"

Dr. FARRAR. I propose that we insert the words "an important factor" in place of "the chief factor."

Dr. STRONG. I second that.

Dr. BROQUET. I propose that the word "probably" be left out. I am sure that the preventive measures have had good results.

Dr. STRONG. This is not a resolution. It is a summary of the evidence. We could only accept the evidence before us. It is not an expression of our opinion.

Dr. BROQUET. The evidence makes it more than probable.

Dr. STRONG. You must read over the whole of the evidence.

Dr. CHRISTIE. If you leave in the word "probably," you weaken the value of the statement.

Dr. FARRAR. The committee could not find it possible to say that it was more than probable.

Dr. MARTINI. I propose that we accept No. 2 as it stands without any alteration.

The amendments were withdrawn.

No. 2 was then passed *nem. con.*

The CHAIRMAN. No. 3 is now before the meeting.

Dr. GRAY proposed and Professor KITASATO seconded that it be carried, and this was agreed to *nem. con.*

The CHAIRMAN. We now come to Nos. 4 and 5.

Professor ZABOLOTNY. Although there may not have been conclusive evidence of infection through clothing, it is quite possible that it may occur.

Dr. STRONG. I quite agree with Professor Zabolotny; this is merely a summary of the evidence.

Professor ZABOLOTNY. But it may be understood to mean that it is altogether impossible for infection to be carried by the clothing.

Dr. PETRIE proposed and Professor SHIBAYAMA seconded that No. 4 be passed, and this was carried.

The CHAIRMAN. No. 6 is now before the meeting.

Professor ZABOLOTNY proposed and Professor KITASATO seconded that this should be carried.

Dr. CHRISTIE. Are three to five days meant as the average period of incubation?

Dr. PETRIE. It does not exclude other terms. We simply state that as a rule it is from three to five days.

Dr. CHRISTIE. Then I think it is all right as it stands.

Dr. GRAY. There have been several cases where the incubation period has been two days.

Professor GALEOTTI. I propose to take out the words "characteristically blood stained" and say only "until the specific bacilli have been recognized in the sputum." That is the only certain means of diagnosis.

Dr. STRONG. We say one or the other.

Professor GALEOTTI. Blood-stained sputum is not sufficient for a certain diagnosis.

Dr. STRONG. All doctors are not able to make a bacteriological examination.

Dr. GRAY. I propose that the incubation period be altered to from two to five days.

Dr. STRONG. I quite agree with that.

The CHAIRMAN. I think it should be from two to seven days.

Dr. STRONG. Seven is too long.

The conclusion with the alteration of three to two days was then adopted *nem. con.*

No. 7 was adopted *nem. con.* on the proposition of Dr. MARTINI, seconded by Professor KITASATO.

Dr. FARRAR proposed and Dr. GONZALEZ seconded the adoption of No. 8.

Dr. STRONG. I understand that Dr. GRAY suggests that the word "duration" should be omitted.

Dr. FARRAR. I think it should be left in.

No. 8 was then adopted *nem. con.* as it stood.

No. 9 was carried on the proposition of Dr. PETRIE and seconded by Dr. DI GIURA, Professor ZABOLOTNY alone dissenting.

No. 10 was proposed by Dr. MARTINI and seconded by Dr. FARRAR.

Dr. GRAY. I think this should be made a little more definite. You say "seems to have."

Dr. MARTINI. We are only going on the evidence.

Dr. GRAY. We know from the evidence laid before us at the Conference that it has been.

No. 10 was carried with the substitution of "has been" for "seems to have been."

No. 11 was proposed by Dr. STANLEY and seconded by Dr. FARRAR.
It was adopted *nem. con.*
The Conference then adjourned until the afternoon.

DRAFT RESOLUTIONS OF COMMITTEE ON SECTIONS D 2, h TO j

[Members: Drs. Wu, Di Giura, Gonzalez-Fabela, Haffkine, and Farrar.]

h. *Methods of removal and disposal of plague corpses*

We recommend that plague corpses when found should be wrapped in coarse sheets soaked in sublimate solution and removed in special tin-lined, covered carts provided for this purpose.

The burial staff should be provided with iron hooks to facilitate the removal of corpses.

In view of the length of time during which plague corpses may remain infective, we are of the opinion that the quickest, safest, and most economical method for their disposal is complete cremation with wood and kerosene oil in special pits previously prepared for the purpose, which should be situated at a convenient distance from the town or village affected.

i. *Organization of the sanitary staff*

There should be in each administrative district (*hsien*) a permanent nuclear medical and sanitary staff, capable of rapid expansion and ready for dealing with any outbreak of plague that may occur.

So far as possible, a uniform system of administration should be prescribed for all districts.

The quarters for the sanitary staff should be isolated under the best practicable conditions.

j. *Precautionary measures*

We recommend that the sanitary staff, as far as practicable, should be inoculated with plague vaccine before commencing their duties.

At the same time, in view of the special danger of infection by inhalation that has been manifest during the past epidemic, we recommend that the sanitary staff should be provided with masks of uniform pattern and instructed in their proper use.

In our opinion the best and most economical form of mask is a simple, three-tailed gauze pad which should be destroyed after each tour of duty and replaced by a fresh one.

The sanitary staff should also be provided with gloves and overalls, which should be of impermeable material.

On coming off duty each member of the staff should take a bath and leave his working clothes to be disinfected at headquarters.

The sanitary staff should be medically inspected each day.

DRAFT SUMMARY OF THE PROVISIONAL CONCLUSIONS OF THE EDITORIAL COMMITTEE

[Members: Drs. Strong, Martini, Aspland, Petrie, and Stanley.]

1. From its origin in northern Mongolia, the epidemic followed a clearly defined course eastward and southward, its diffusion having been principally determined by routes of travel, especially railways, roads, and shipping. The disease was spread by direct infection from man to man,

and whatever may have been its primary origin, there is no evidence that a concurrent epizoötic in rodents played any part in its original dissemination.

2. The chief factor in the decline of the epidemic has probably been the preventive measures which were enforced either in accordance with scientific methods or by the crude efforts of the people to protect themselves. Climate influences may have contributed indirectly or even directly toward bringing the epidemic to an end, but the evidence presented on these points is inconclusive. The decline has not been due to any loss of virulence of the bacillus.

3. Infection was introduced into towns and villages by persons actually suffering from plague or by those in the incubation stage of the disease.

4. There has been no positive evidence to show that infection has been spread by clothing, merchandise, or other inanimate objects.

5. Overcrowding has undoubtedly contributed to the spread of the disease within houses by multiplying the chances of infection.

6. The epidemic has been, almost without exception, one of primary pneumonic plague. The incubation period varies as a rule from three to five days. A rise in temperature and an increased pulse-rate are usually the earliest symptoms observable, but a diagnosis can not be made until the specific bacilli have been recognized in the sputum or until the sputum has become characteristically blood stained. An accurate diagnosis can be made only by a bacteriological examination of the sputum with the view of excluding pneumonic infections due to other microörganisms. Since the evidence points to the conclusion that in the past epidemic all the cases were septicæmic, an examination of the blood microscopically or culturally may be a valuable aid in diagnosis.

The physical signs of lung involvement are too indefinite and appear too late in the course of the disease to be of diagnostic value, and even in cases in which the condition of the patient is grave they may be very slight.

7. The fatality of the disease during the past epidemic has been extremely high, scarcely any cases of recovery having been reported.

8. The general experience has been that no method of treatment has been of any avail in saving life, but the serum treatment seems, in a few instances, to have prolonged the duration of the illness, and even one or two cases of cure have been attributed to its use.

9. The strain of bacillus isolated during the past epidemic has differed in no essential respect from the strains of *Bacillus pestis* previously isolated from other sources.

10. So far as can be ascertained, the only infective agent in the epidemic has been the sputum of the plague patient. In the majority of cases the disease seems to have been contracted by the inhalation of plague bacilli in droplets of sputum, causing infection of the lower portion of the trachea and the bronchi. Primary infection of the tonsils, presumably due to contamination of the throat with sputum, however, has occasionally occurred.

11. In the case of infection by inhalation, the risk to the person exposed bears a direct relation to his proximity to the patient and the duration of exposure.

SECTION XXI, APRIL 26

PROGRAMME

I. Discussion and adoption of resolutions (Nos. 44 and 45 of the Interim Report, see p. 397) on D 3, "Measures to be taken to prevent a widespread diffusion of infection."

II. Discussion and adoption of resolutions (Nos. 17–21 of the Interim Report, see p. 392) on D 2 g, "Means of disinfection."

Dr. Wu took the chair at 2.25 p. m.

DISCUSSION OF RESOLUTIONS ON SECTION D 3

Dr. FARRAR. I take it we have met to discuss the further resolutions of the committee on D 3. I have to submit these resolutions to the Conference as the practically unanimous opinion of the committee. I propose that they be passed *en bloc*. I withdraw the amendment that I proposed this morning, and propose that the further resolutions as circulated be adopted *en bloc*.

Dr. WORELL seconded this proposal.

Dr. FARRAR. Of the committee, six have signed the resolutions as they stand, and the seventh agrees with them in principle but is unable to express the opinion that it is advisable to pass them in such detail.

The CHAIRMAN. I see there is a reference to a secretary at Peking. What does that mean? A secretary of state, or what?

Dr. FARRAR. A secretary of state, yes. A responsible official.

Dr. PETRIE. You say "under a responsible secretary." If you mean a secretary of state would it not be better to say so.

Dr. STRONG. Would it not be better to make this a special report rather than a resolution of the Conference. It could be forwarded as a special memorandum. We can not really resolve that a country should do all these things.

The CHAIRMAN. We are asked to report upon measures to be adopted to fight future epidemics. I do not think a resolution providing for a secretary of state can be within our province.

Dr. FARRAR. Means of notification can only be had with a government department. Unless you have means of notification, you can not prevent plague.

The CHAIRMAN. I believe that in England you have no secretary for public health.

Dr. FARRAR. That comes under the local government board. Perhaps the resolution might be worded "a public health department under a secretary of state."

Dr. STRONG. Then we shall be trying to reorganize the Government.

The CHAIRMAN. We are not asked to organize a secretarial staff in Peking.

Dr. PETRIE. This recommendation proposes something better than we have in England.

Dr. GRAY. It begins where we leave off.

Dr. PETRIE. If we are going in for ideal recommendations, I think we had better say so.

Dr. FARRAR. I suggest that we vote upon resolutions 13 to 17 as a whole, and if they are rejected then it will be open to us to change them by an amendment similar to the one I proposed this morning.

Dr. STRONG. I really think that we, as scientific men, should give some very serious consideration to these resolutions. This is a scientific congress, and if we pass resolutions of this kind we will, I fear, make ourselves appear ridiculous. It will be said that the men who drew them up can not have understood what they meant. We can not really undertake to reorganize a state department.

Dr. STANLEY. I am of the opinion that the deliberations of this assembly were largely limited to the discussion of pneumonic plague, the recommendations to the Chinese Government should not enter into details of sanitary organization generally.

Dr. HEHEWERTH. Let me read what His Excellency Alfred Sze said in his opening address: "Gentlemen, in asking your consideration of these questions and any other suggestions which you may, from your past experience see fit to make, I will, on behalf of my Emperor and Government, respectfully beg of you to ever have the practical side of the subject in view. Science comes often into conflict with daily life, just as it is ever aiding it. What may be scientifically and theoretically desirable may, when the time comes for it to be put into actual practice, be found impossible to carry out; but we are determined to meet this enemy henceforth armed with the best knowledge we can obtain. We will thoroughly consider your recommendations, and whenever possible act up to them. The day has now gone past when any government can allow an epidemic to cause such ravages among its people unchecked, not only for economic but also for humanitarian reasons."

Professor GALEOTTI. The best advice we can give is for the general sanitation of the country.

Dr. FARRAR. This speech has been discussed all round, and I do not think we can get any further by discussing it. I suggest that we vote upon resolutions 13 to 17 [1] *en bloc*, or take them seriatim.

The CHAIRMAN. I think the whole Conference must first understand the situation and the scope of its duties.

Dr. FARRAR. We understand that.

The CHAIRMAN. I am not sure whether you understand the situation in Peking at all. Do you know, for instance, what a board is? We must understand where we are. I do not think you know what a president is. It would be better to talk the matter over first and vote afterward.

Dr. FARRAR. I beg to suggest that we vote upon No. 13. If rejected, an amendment to it can be discussed. Is there any amendment before the house?

Dr. GRAY. I signed these resolutions in principle, but not in detail. The principle was that it certainly seemed to me that it would be a very good

[1] These resolutions as proposed will be found at the close of this session on page 374; as finally passed they will be found in the Interim Report, page 397 [44].

thing for China to have some sort of sanitary medical service. She has not any organized sanitary service at present. The details that I would not say I object to, but what I do not agree with is where the resolutions go on to provide that the service shall be under a responsible secretary, and that there shall be a medical officer having the right of direct access to the secretary, and that there shall be a staff of medical inspectors. I think that in making such recommendations we are going a little beyond our province. I thought I should be going a little beyond my province in signing in favor of these details. The principle which I was in favor of was that it would be a good thing if, out of this Conference in which we have learned that sanitation in China is lacking in many important aspects, we could, as the result of our findings of these failings, evolve some idea that a sanitary service would be a good thing for China, but in regard to the details we are certainly going a little beyond our province.

Dr. ASPLAND. Would it answer our purpose if we simply recommend the Government to organize a central public health department?

Dr. CHRISTIE. Dr. Gray's difficulty is exactly my own. If we ask the Government to establish a new department, we are interfering with the government of China. We are going beyond our range even to suggest to China that she should have a responsible secretary. We could recommend the establishment of a board of health and leave it there without going any further. Let the Chinese Government then appoint a minister or a secretary or any other official she thinks right. We can certainly go the length of advising the establishment of a public health department.

Dr. PETRIE. I think we should confine ourselves to pneumonic plague and not to a general health department. I should like to recommend that we substitute, for the present resolution, words to the effect that in view of future epidemics of pneumonic plague that may occur, we recommend the Central Government to establish an antiplague bureau, or something of that kind.

Dr. FARRAR. As it seems to be impossible to carry these resolutions through, personally I should like to make my position clear. They have been passed by the whole committee. Then, in deference to what was told me by members of the committee, who had passed these resolutions at the time, as to the administrative difficulties, I was willing to withdraw the resolutions. But the committee was not willing to withdraw them. Now that it does not seem feasible to pass them through, I offer the following alternative resolution: That with a view to prompt dealing with future epidemics that may occur, we recommend that provision be made for the immediate notification of the outbreak of plague to a central public health office, which should be established at as early a date as possible.

Dr. CHRISTIE. That seems to me to cover all the essential points that are brought out in the original resolution.

Dr. FARRAR. We have not made the importance of prompt notification clear in any of the other resolutions, and as we are now dealing with the widespread diffusion of the epidemic, I think we should recommend the establishment of a central public health office.

Professor GALEOTTI. Before the amendment is put, I think that the original resolutions should be put to the Conference and adopted or rejected. Let our resolutions be rejected before Dr. Farrar's amendment is considered.

Dr. CHRISTIE seconded Dr. FARRAR's amendment.

Dr. GRAY. I think the amendment is a very reasonable solution.

Professor GALEOTTI. What is the Conference going to do with the resolutions of the committee? They must be voted upon.

Dr. GRAY. I think that the amendment should be put first.

The CHAIRMAN. I appreciate deeply the trouble taken by the committee in drafting these resolutions. The only trouble is that we should always remember not to go beyond the scope of our work. If Dr. Farrar, on consideration, thinks that he desires to amend these resolutions by suggesting another resolution which covers them, perhaps the Conference may consider it favorably.

Dr. GRAY. It is only reasonable to suggest some such scheme of notification in future.

Professor ZABOLOTNY. I think that the amendment makes the resolution worse. The amendment is only in general terms, and I am of the opinion that it would be far better to have something more specific. There are many important details to be considered. Information must be telegraphed to the other nations, and the neighboring districts should be informed also. A general sanitary service is the best for combating plague pneumonia, and, therefore, I think that we should stick to the details in the original resolutions and not to the general terms of the amendment.

The CHAIRMAN. The motion before the Conference now is Dr. Farrar's amendment.

Dr. FARRAR. Perhaps another way out of the difficulty would be to accept my amendment, and, if the Conference is willing to do so, to allow a memorandum containing the details of the original resolutions to be handed to His Excellency Alfred Sze.

The CHAIRMAN. I believe it is the opinion of the Government that memorandums would be welcome as to the management of sanitary affairs and so on.

Dr. FARRAR. I feel about this matter so strongly that I think a memorandum, embodying these points, should be drawn up and handed to His Excellency Alfred Sze, so as to be certain that the Government has our advice, even if it is only semiofficially. For our official advice I do not think we can go further than my amendment. It embodies the provisions for a central health department and for earlier notification.

Professor KITASATO moved that these resolutions be omitted altogether.

Dr. FARRAR. I think that we should be very much failing in our duty if we did not pass a resolution providing for a department to which prompt notification should be made. We are all agreed that prompt notification is necessary and in regard to the machinery necessary to secure it. These provisions are of the utmost importance. If we part without giving the Chinese advice that machinery for prompt notification should be started, we should absolutely fail in one of our most important duties. The amendment I have proposed provides everything necessary without overloading it with details, and without having the appearance of dictating details to the Imperial Government.

Professor KITASATO. If this amendment is passed it will not give any fresh information to the Chinese Government. The Chinese Government knows the necessity for it well enough already.

Dr. FARRAR. We advise prompt notification and the machinery for it. That is new and most important. I propose that these resolutions 13 to 17 be omitted and that my amendment be substituted for them.

Professor ZABOLOTNY. I can not sign such a resolution, because it is

much too general. It was unnecessary to call a Conference to pass such a resolution. I agree with Professor Kitasato.

Dr. FARRAR. The machinery for prompt notification, as suggested in my amendment, is very definite.

The CHAIRMAN. I shall have to place Professor Kitasato's amendment before the meeting.

Dr. GRAY. I do not quite understand Professor Kitasato's attitude. Does he mean that we should hand these resolutions in to the Chinese Government and avoid any word or hint as to how they should be carried out effectively?

Professor KITASATO. In the first sessions of the committee, most of the members refused to accept these resolutions. Afterward they were introduced again and finally accepted. Just after they were accepted it was proposed to delete them again. Now an amendment comes on, and we do not know what will happen next. I think it would be better to drop the whole thing. The resolutions could be handed over to the Chinese Government as they really deal with the administrative work of the Government.

Dr. FARRAR. May I explain that at the first session of the committee a definite proposal to include these resolutions was made, and we could not come to an agreement upon them. We then agreed to postpone our discussion upon them until the draft resolutions, which have already been accepted, were passed. We postponed the discussion of the contentious resolutions to another day. That is all that happened.

Dr. TEAGUE. As a practical proposal that may suit everyone I suggest that the words "under a responsible secretary with an office in Peking, etc.," to the end of the resolution, be deleted.

Dr. BROQUET. I suggest that the resolutions 13 to 16 be deleted and that we leave No. 17 as 13, as it appears to me to cover the whole ground. If the International Sanitary Convention of Paris be followed, there is provision in that for a health department, etc. I do not think any purpose would be served by putting in more detail than that.

Dr. GRAY. I propose as an alternative amendment that we adopt the following:

"The Conference is of the opinion that, with the view of giving effect to many of its recommendations, the Imperial Government should be advised to use every endeavor to organize a central public health department, more especially with regard to the management and notification of future outbreaks of infectious diseases."

Dr. GONZALEZ-FABELA. I second that.

Dr. GRAY. That is practically the same as Dr. Farrar's amendment, but in more general terms.

Dr. FARRAR. I am quite willing to accept that. I consider it is just the same as mine.

Dr. GRAY. We have not heard any explicit reasons why members of the Conference are against this amendment or against Dr. Farrar's.

The CHAIRMAN. Is it your idea that the remaining resolutions should be deleted in favor of your amendment?

Dr. GRAY. All but 18 [45].[1]

[1] Numbers in brackets refer to the number of the resolution in the Interim Report on page 397.

Professor ZABOLOTNY. I understood that Professor Kitasato's proposal, either to take the resolutions as they stand or omit them altogether, was before the meeting.

The CHAIRMAN then put Dr. Gray's amendment to the meeting, and it was carried, the German, British, Mexican, American, Netherlands, Italian, French, and Austrian delegations voting in favor of it.

Resolution 18 [45] was then proposed by Dr. FARRAR, seconded by Dr. STANLEY, and adopted *nem. con.*

DISCUSSION OF RESOLUTIONS ON SECTION D 2 g[1]

The Conference then proceeded to consider the *Draft resolutions of the committee on D 2 g.*

RESOLUTION 1 a (1) AND (2)

Dr. STRONG. I move that 1 a (1) and (2) be accepted with the exception of the words "Or dried by dry heat and exposed to the sun for three days." I do not think that is practicable. It might be raining at the time and the sun not shining.

Professor GALEOTTI. I propose that we omit the words "If of no value it may be burnt," and all the words after "vapor" in the second part. I do not think articles should be exposed to the sun for disinfection.

Professor SHIBAYAMA. Some clothes are very easily spoiled by other disinfectants, and then the best thing is to put them in the sun. In China there is so much sunshine even in the winter time that we can reckon with it for disinfection.

Dr. STRONG. The sun might be obscured for three days.

Professor GALEOTTI. Such articles might be disinfected with formalin without any sunshine at all.

Dr. PETRIE. I think we might agree with sun disinfection here, because we are talking about the clothing and bedding of contacts. I should think that sun disinfection would suffice for the clothing and bedding of contacts.

Dr. GRAY. For the benefit of those Delegates who do not know the climate of north China and Manchuria, I may explain that it is like that of Switzerland. It is sunny all day long. Very occasionally there is a dust storm. There is snow at the beginning of November or thereabouts, but very rarely in the middle of the winter. Toward the end there is snow again. On the whole it is extremely dry, cold, and sunny.

Dr. STRONG. Plague was here in March, was it not?

Dr. HILL. For Dr. Strong's information I may say that this spring has been absolutely exceptional. Such weather has not been known in north China for about twenty years. It is absolutely unusual.

The CHAIRMAN. This resolution does not preclude the use of formalin vapor.

Dr. STRONG. I only thought that sunshine was rather an uncertain method of disinfection for this purpose. We are presumed to be making scientific recommendations.

Professor GALEOTTI. I think it would be dangerous to say that sun exposure might be regarded as sufficient. No one will employ a disinfectant for things that are of no value. Of course, such articles would be burnt.

[1] These resolutions as proposed will be found at the end of the proceedings of the session, on page 374; as finally passed they will be found in the Interim Report, page 392 [17–21].

Dr. Gray. I move the adoption of a (1).

Dr. Farrar seconded the proposition.

Dr. Strong. I suggest that it should read "should be burnt."

With this amendment a 1 [17] was adopted *nem. con.*

a (2) [17]

Dr. Strong moved and Professor Galeotti seconded an amendment to omit the words after "vapor."

Professor Galeotti. If this resolution is adopted as it stands, everyone will be exposing their articles to the sun and no carbolic or sublimate or any other disinfectant will be used.

The Chairman. I put Dr. Strong's amendment to the meeting.

Dr. Gray. If I have a valuable fur coat in the house, I suppose there would be no objection to my putting it in the sun for a few days.

Dr. Strong's amendment was then put to the meeting and lost. Those who voted in favor were the Delegates of Germany, America, Mexico, France, and Italy. Those against were China, Russia, Japan, Great Britain, Austria, and the Netherlands.

Professor Galeotti. I desire to have the opinion of the minority recorded that the sun is not sufficient to insure sterilization of clothing.

Dr. Hill. Dry heating is included before exposure to the sun, as an essential part of the disinfection.

Dr. Farrar then proposed that a 2 [17] as it stood should be passed. This was seconded by Professor Shibayama and was carried. The Russian, British, Japanese, Austrian, Netherlands, and Chinese delegations voted for, and the German, Mexican, American, and Italian against the proposal.

Dr. Strong. I should just like to remind the Conference that we are here to pass accurate and careful resolutions. It is not my intention to differ from the committee, but we must remember that our recommendations are going to be examined by scientific men, and, perhaps, will be read in many different parts of the world, and that we shall be criticized in a body for them if they are not accurate. I feel that if we recommended exposure to sunlight as a safe disinfectant for this purpose anywhere in Europe or the United States, we should not be supported.

Dr. Broquet. I quite agree with Dr. Strong that the question of disinfection is most important and difficult, and I wish to say that I feel sure that the committee would be very glad, if the Conference so desires, to alter its opinions in accordance.

Professor Galeotti. There is still my motion that was laid upon the table that the opinion of the minority should also be recorded. I think this is a case where we can not really say that exposure to the sun is a safe method of disinfection.

Dr. Gray. The resolution provides for dry heat, which can be obtained from the open stove in every house, before exposure to the sun.

Professor Galeotti. I have read this through, but I request that the opinion of the minority, that sun exposure is not sufficient, be recorded.

Dr. Farrar. Whenever a vote is taken I believe it is put on record. The question has now arisen whether the nationalities of the minorities are recorded.

Dr. Aspland. If the minority wishes to send in a report, it can simply hand it in in the form of a resolution. Dr. Strong has already had his views placed upon record.

b (1) [18]

Professor KITASATO. What is to be done when there is a corpse in the house?

Professor SHIBAYAMA. If a corpse is found in the house, it is necessary to wait, because there is no coffin at hand.

Professor KITASATO. I think it should be "after the removal of the patient or the corpse."

Dr. HILL. This is meant to be carried out before disinfection, so as to prevent the disinfecting gang getting infected.

Dr. STRONG. It is a little ambiguous. I think it would be better if it read "houses should be sealed up for a few hours immediately after the removal of the patient or the corpse."

In this form the resolution [18] was adopted *nem. con.*

b (2) [18]

Professor GALEOTTI. I think that it is a most dangerous practice to search for sputum or blood. I do not know what the officers are supposed to do, but the chief thing about disinfecting a room is to use vapors or solutions everywhere. I think the first sentence of this resolution should be dropped.

Dr. BROQUET. I do not agree. All disinfections are dangerous, and medical work is also dangerous.

The CHAIRMAN. Are such parties expected to go into every nook and corner to look for sputum, because otherwise what does it imply?

Dr. GRAY. It says "visible." In a general way, I take it.

The CHAIRMAN. What is the object, if one spot is left?

Dr. HILL. Spraying is hardly the most effective way of dealing with large masses of blood and sputum. We thought it would be better to go in and mop up all the sputum on the spot with disinfectants.

Dr. GRAY. I beg to propose that this resolution be adopted.

Dr. MARTINI seconded.

The resolution [18] was carried, the French, Italian, and Mexican delegations dissenting.

b (3)

Dr. FARRAR proposed and Dr. MARTINI seconded the adoption of this resolution.

The CHAIRMAN. I should like to explain that in most of the low-class houses the windows are covered with paper. Does the Conference understand that this is wall paper or not? And does the Conference mean that new paper should be put up before disinfecting?

Professor GALEOTTI. All this is dangerous and useless. Mueller contracted plague because he scraped the walls of a room. It would be better if the rooms were just closed.

Professor ZABOLOTNY. Wall paper must first be treated with a disinfectant solution.

Professor SHIBAYAMA. It is not economical first to disinfect the wall paper first and then to burn it. It would be better to remove it with every precaution and burn it immediately.

Dr. GRAY. With regard to the word "stripped." Wall paper in China is not put on in long strips, but houses are papered with small squares scarcely bigger than a sheet of note paper.

The CHAIRMAN. I think that this is a matter which should be carefully discussed. Is it the desire of the Conference that the sanitary staff should first strip off the wall paper and then bring in the disinfectants?

b (4) [18]

Dr. MARTINI. I propose that we take b (4) [18] first.

Dr. WORELL seconded.

Dr. HILL. I disagree with the committee in regard to this resolution upon all but the first line and a half. In my opinion the rest of this resolution is impracticable in north China, and we are giving advice which could not be carried out in places like villages a considerable distance from a town. There are, say, ten villages near Mukden. Must they all have a sanitary staff with sprays and disinfectants for each? It would be impossible to send them out from Mukden. The other point to which I object is in regard to fumigation by formalin. All the evidence before the Conference has been to the effect that the fumigation of Chinese houses is useless. If sprays are employed, formalin is unnecessary. If they are not, formalin fumigation is useless. Even if the house be pasted up, the roof will let through the vapor. Formalin vapor disinfection is never practiced by those who have experience in China. I should like to propose three alternative resolutions. They are:

That in b (4) the words from "slaked" to "employed" be omitted, and the following words inserted:

"5. Failing this, the *k'ang* should be made as hot as possible and the house sealed up for two days. Quicklime should be ground into the whole surface of the mud floor and sprinkled all over with water. The house should not be inhabited for a week.

"6. Owing to the pervious nature of the roof, fumigation can not be trusted to disinfect most Chinese houses, even when they are well sealed up.

"7. Railway carriages may be fumigated with formalin.

Professor SHIBAYAMA. Because we knew that these Chinese houses could not be properly disinfected by formalin, we added the words "when a house can be rendered air-tight." This form of disinfection is possible in sleeping cars, and therefore must be used, because other forms of disinfection would spoil valuable cars. Of course, we know that many Chinese houses can not be properly fumigated.

Dr. HILL. It is impossible to say without trying to find out whether a house is air-tight or not. A great amount of time and money would be wasted. This method has been tried for many years in China, but is never trusted. Therefore, it seems to me misleading here to insert anything about formalin disinfection of houses.

Dr. PETRIE. It seems to me that the suggestion of Dr. Hill that the *k'ang* should be heated is a very good one. It is usually the most infected part of the house, I suppose, and heating would destroy all the bacilli. It seems to me a very effective method.

Dr. HILL. Could we not have my proposals typewritten and leave this resolution until to-morrow and pass on to the rest of the resolutions of this committee?

The CHAIRMAN. This resolution says "if the house can be rendered air-tight." Is the Conference satisfied that, if it can not be, spraying is sufficient?

Dr. HILL moved that the words from "slaked" to "employed" be omitted and the resolution he had proposed substituted.

This was seconded by Dr. FARRAR.

Dr. GRAY. Is there any information to show that, if a certain type of

stove were put into a house and kept hot for a week, that would be sufficient disinfection?

Dr. STANLEY. I quite agree with Dr. Hill's amendment. I think it would be an excellent method to adopt in places where disinfectants could not be obtained.

Dr. HEHEWERTH. You say if disinfectants can not be obtained.

Dr. HILL's amendments were then put to the meeting and lost, only the Chinese, British, and Mexican delegations voting in favor.

Dr. FARRAR. I now move that b (4) be passed.

Dr. HEHEWERTH. I second that.

Dr. HILL. I propose as an amendment that the last two lines be left out.

Dr. HEHEWERTH. In every Chinese city there are some houses that could be rendered air-tight.

Dr. HILL'S amendment was not seconded.

b (4) [18] was then carried as it stood.

Professor GALEOTTI. I move that b (3) be deleted.

This motion was seconded by Professor ZABOLOTNY and carried.

b (5) [18]

Professor ZABOLOTNY. In Harbin third-class cars and goods were disinfected by steam. A thermometer was put into the car, and the latter was then run up to the engine and steam was turned on.

Dr. STRONG. I suggest that we add the words "or by steam."

With this amendment b (5) [18], was adopted *nem. con.*

c (1) [18]

Professor GALEOTTI. I raise the same objection as before. I ask the committee to say whether the exposure of an article, such as a chair, to the sun is to be regarded as a sure means of disinfection. So I move that the words "or exposure to the sun" be omitted. That would always be done, and the goods would be considered disinfected if we passed this resolution.

Dr. STRONG. I second that. I think it is dangerous to recommend. I think it would be better to say nothing about it. Let us vote on it.

Professor ZABOLOTNY. Wooden furniture could be washed with lysol, and upholstered furniture could be taken to disinfecting rooms and disinfected with formalin vapor.

Dr. BROQUET. Everything could also be sprayed and swabbed with disinfecting solutions.

Professor GALEOTTI. I am willing to allow the resolution to stand if you insert after the word sun, the words "after proper fumigation."

Dr. GRAY. There is no evidence at all before the Conference that infection has ever been carried by a chair or any other inanimate object.

Dr. ASPLAND. The editorial committee says that "there has been no positive evidence to show that infection has been spread by clothing, merchandise, or other inanimate objects."

Professor GALEOTTI. Then do not disinfect anything.

Professor SHIBAYAMA. I have worked very often in connection with disinfection. I have had considerable experience with things which must be disinfected in one way or another. Some must be disinfected by formalin or steam. That is my experience.

Dr. FARRAR. I suggest that we should substitute "and" for "or" and vote on c (1).

Dr. BROQUET. I second that.

The resolution [18] with this amendment was carried, the Italian and Japanese delegations dissenting.

c (2) and (3) [18] were carried *nem. con.* without discussion.

d (1) [19] was also carried *nem. con.* without discussion.

d (2) [18]

Dr. FARRAR. This is not very well drawn up. Would it not be better to say "when disinfection is necessary, any suitable method," etc.?

Dr. STRONG. I move that we omit resolutions d (2) and (3).

Dr. FARRAR. I move that d (2) be omitted.

Dr. STRONG. I second that.

This was carried.

Dr. STRONG. I move that (3) be omitted.

Professor GALEOTTI. I second that.

Dr. HILL. This question was one that was asked a good many times during the past epidemic. We were frequently asked what ought to be done with bags and grain.

The motion to omit this resolution was carried.

Professor GALEOTTI proposed and Dr. STRONG seconded that d (4) be omitted also.

Dr. HILL. If that is agreed to, I think some alternative directions ought to be given.

The CHAIRMAN. I think that we ought to say something definite about these goods.

Professor GALEOTTI. We might say that suspected articles should be stored in a dry room—I don't think that three weeks will be sufficient. It is very difficult to say for how long.

Dr. STRONG moved and Professor KITASATO seconded that the resolution be omitted, and this was carried.

Dr. FARRAR. The provisions of the Paris Convention ought to be satisfactory.

Dr. HILL. We were dealing with trade articles known to have been exposed to infection. We have again and again been asked what ought to be done with grain and other articles found in infected houses.

Dr. GRAY. In an agricultural country like this, you often see bags of grain in a patient's bedroom.

Dr. FARRAR. We have already agreed to this: The evidence before us is to the effect that it is unnecessary and undesirable, in respect of pneumonic plague, to restrict the transit of goods (other than personal luggage) and of mails.

The CHAIRMAN. If there are no alterations to be made to d (1) [19], we may pass on.

RESOLUTION 2 [18]

Professor ZABOLOTNY. In some houses there are so many insects and there is so much dirt that it is impossible for disinfection to be effective, and such houses should be destroyed. The first sentence in this resolution says that it is never necessary to destroy houses.

Dr. GRAY. I propose as an amendment that instead of the resolution as it stands we should make it read "house burning should not be carried out where it is reasonably possible to disinfect."

Dr. STRONG seconded this proposal [18], which was carried.

RESOLUTION 3 [20]

Resolutions 3 a to c [20] were carried *nem. con.*

Dr. STRONG proposed that 3 d should be omitted.

Dr. HEHEWERTH. I was told that permanganate of potash was used in China.

Dr. HILL. I said that many people used it.

The CHAIRMAN. If we mention permanganate of potash, we might also include sulphur. Why make any recommendations regarding disinfectants which have not been used?

Professor ZABOLOTNY. There are many disinfectants which are of no use, but only one of them is mentioned. I second the motion.

The motion to omit 3 d was put to the meeting and carried.

RESOLUTION 4

Dr. GRAY. I move that No. 4 be accepted.

Professor ZABOLOTNY. There has been a tendency to avoid unnecessary detail. Here we are going into very delicate questions of detail.

Dr. FARRAR. I agree with Professor Zabolotny.

Dr. CHRISTIE. I move that resolution 4 be deleted.

Dr. MARTINI seconded.

Dr. HILL. We were specially asked in the programme to give directions for disinfection in a rigorous climate. Therefore, we put this in because we understood that the freezing of sprays was a source of great trouble in many places.

The motion to omit resolution 4 was carried.

RESOLUTION 5 [21]

Dr. MARTINI proposed and Dr. HEHEWERTH seconded that this resolution be adopted.

Dr. GRAY. Is this intended to apply throughout China or only in Manchuria?

Dr. WORELL. It is intended to apply to every large town in the Chinese Empire.

The CHAIRMAN. What is a large town, please? Supposing one town has a population of 20,000, and another a population of 200,000, which is a large town?

Dr. GRAY. Does this mean the creation of 20,000 permanent sanitary forces?

Dr. CHRISTIE. I do not think this is practicable.

The CHAIRMAN. We must first know what a large town is.

Dr. FARRAR. Leave it to the discretion of the Government.

The CHAIRMAN. There is a great deal of difference between a town of 20,000 and one of 200,000. Would it not be better if you said in each capital of a province?

Dr. STRONG. Every large town ought to have one.

Dr. FARRAR. There should be one in each of the more important towns.

Dr. CHRISTIE. I propose as an amendment to substitute for "in every large town," "in every provincial capital."

This was seconded by Dr. GRAY and carried. [21]

RESOLUTION 6

Dr. GRAY. I think we should insert the words "it is desirable."

Dr. FARRAR seconded the substitution of "it is desirable" for "we advise."

Professor KITASATO moved and Professor GALEOTTI seconded that this resolution be omitted.

This was agreed to and the Conference then adjourned until the following day.

FURTHER DRAFT RESOLUTIONS OF COMMITTEE ON D 3

13. With a view to prompt dealing with future epidemics that may occur, we recommend that the Imperial Government should organize a public health department under a responsible secretary with an office in Peking. The department should include a medical officer, having the right of direct access to the secretary, and a staff of medical inspectors.

14. Medical officers of health and sanitary inspectors should be appointed for each province and for all the larger towns of the Empire.

15. The duties of the local sanitary medical service should include the prompt notification to the central office of outbreaks of epidemic disease.

16. The occurrence of epidemic outbreaks of plague should be promptly notified to all the Powers, to all administrative districts adjacent to the infected area, to the above-mentioned joint railway medical board, and to the Imperial maritime customs service.

(The progress of the epidemic should also be notified by means of periodical bulletins.)

17. The Imperial Government should, at the earliest possible date, conform to the principles of the International Sanitary Convention of Paris, 1903.

18. In furtherance of the above purposes, every effort should be made to secure effective medical education in China.

DRAFT RESOLUTIONS OF COMMITTEE ON D 2 g

[Members: Drs. Worell, Shibayama, Hehewerth, and Hill.]

1. Disinfection of—
   - a. *Clothing, bedding, etc.:*
     - (1) Clothing and bedding of the patient should be thoroughly disinfected by steam, boiling, or prolonged soaking in a disinfectant solution. If of no value, they may be burnt.
     - (2) Clothing and bedding of contacts should be disinfected by steam, boiling, or spraying thoroughly with a disinfectant. Articles that would be spoiled by such treatment may be disinfected with formalin vapor or dried by dry heat and exposed to the sun for three days. The whole surface must be exposed in turn.
   - b. *Houses.*—Houses must be disinfected in the following manner:
     - (1) Houses should be sealed up for a few hours after removal of the patient.
     - (2) Search should be made with a good light for visible contamination with blood, sputum, etc. Such contamination must be forthwith disinfected or removed and burnt.
     - (3) Wall paper should be stripped and burnt.

(4) The house must then be sprayed and swabbed with a disinfectant solution. Slaked lime may be spread evenly on a mud floor. When a house can be rendered air-tight, fumigation with formalin may be employed.

(5) Cars may be disinfected in the same way as houses.

c. *Furniture:*

(1) This may be included in the disinfection of the house or treated by fumigation or exposure to the sun.

(2) The spittoon must be thoroughly disinfected.

(3) The *k'ang* mat and all rubbish should be burnt.

d. *Trade articles:*

(1) Except rags and old clothes, these need not be disinfected unless they are known to have been exposed to infection.

(2) Any suitable method of disinfection may be used, or the article may be stored in a dry room above freezing temperature for three weeks.

(3) Closed bags of grain, etc., may be sprayed on the outside.

(4) Exposed grain, etc., may be dried and exposed to the sun, after removal of the top layer, to the depth of one inch.

2. *House burning:*

It is never necessary to burn a house in order to disinfect it. At the same time, an ill-ventilated, overcrowded, insanitary quarter is dangerous to the community at all times, and especially during epidemics. Such premises should be evacuated in time of epidemic plague and perhaps destroyed if suitable accommodation can be found for the persons dislodged.

3. *Efficacy of disinfectants:*

a. For disinfection of sputum, carbolic acid, if possible with soap or alkaline coal-tar products (cresols), are recommended.

b. Many satisfactory preparations of cresols are sold under special names, but no proprietary disinfectant should be used until its potency and properties have been scientifically investigated.

c. Other useful disinfectants are chloride of lime, slaked lime, formalin, and perchloride of mercury (the latter not for masses of sputum).

d. Permanganate of potash is not recommended.

4. *Spray disinfection in a cold climate:*

A spray should be fine and forcible. Narrow cylinders and metal piping should be avoided. The reservoir should be closed and should measure about the same in each dimension. The mechanism should be central, and the solution capable of being kept hot.

5. To make these measures of disinfection effective, it is of the utmost importance that there should be a sufficiently large body of trained men to carry them out; and the best method of securing this object is to set up in every large town a permanent establishment and disinfecting staff.

6. In view of the immense, practical importance of a right distribution of energy and money in pneumonic-plague measures, we advise that systematic experiments be carried out with a view to determining the degree and duration of infectivity of houses for susceptible animals under various conditions of climate, temperature, etc., if an opportunity should present.

SESSION XXII, APRIL 27

PROGRAMME

I. Discussion regarding slight alteration in provisional conclusion No. 4 of the Interim Report (see p. 389) regarding the possibility of clothing carrying infection.
II. Discussion and adoption of resolutions (Nos. 10–16 of the Interim Report, see p. 391) on D 2, "Measures to be taken to limit the spread of infection in an infected town or village," sections a to f.
III. Discussion regarding preamble for the Interim Report.

DISCUSSION REGARDING CONCLUSION [4]

Dr. WU took the chair at 10 a. m.

The minutes of Sessions XX and XXI were confirmed.

Dr. STRONG. I have been asked to call the attention of the Conference to section 4 (see Interim Report, p. 389) of the conclusions of the editorial committee. It has been objected to as perhaps being a little too sweeping. The idea conveyed is, perhaps, not quite clear. I propose that we should add the words "however, evidence has been submitted to show that infection might result from articles of clothing infected with moist sputum." Professor Zabolotny has said that a man handling clothes with wet sputum on them might become infected, and he claims we have omitted the evidence on this point. Dr. Petrie suggests that we should leave out the word "however."

Professor KITASATO. Drop the whole paragraph.

Dr. STRONG. This is a summary of the evidence. In making this summary, we omitted to state that there was this evidence. Professor Zabolotny has given evidence, not that any example of infection by this means has occurred, but that it might occur. We can not change the evidence.

Dr. FARRAR. There is not any such thing as evidence of what might happen. It is stated that there is no positive evidence.

Dr. GRAY. Evidence has been produced to show that infection might result. You can produce a revolver as evidence that a man might have shot someone.

Dr. STRONG. Let us vote upon it and pass on. If the Conference does not want the addition, leave it out.

Dr. ASPLAND. If there is any alteration to section 4 it has been suggested that it should read "evidence has been submitted that moist sputum on any inanimate object is capable of conveying infection."

Dr. STRONG. There is no evidence to show that at all. It is only on clothing.

Dr. CHRISTIE. I think that if there is the slightest possibility of infection being carried upon clothing that ought to be added. It is a very serious question, and the omission might lead to disastrous results.

Dr. FARRAR. How would it do to have the section read: "While it is obvious that articles contaminated with the moist sputum of plague patients are potentially infective, there has been no positive evidence, etc."

Dr. GRAY. I second Dr. Strong's motion.

Dr. PETRIE. Perhaps the editorial committee might reread the evidence upon this point, and submit its conclusion to the Conference.

The CHAIRMAN. I am afraid that we must finish these resolutions this afternoon.

Dr. CHRISTIE. I second Dr. Petrie's proposal.

Dr. GRAY. Dr. Strong's amendment is purely and simply a statement of fact.

Dr. CHRISTIE. There is no reference to other inanimate objects.

Dr. STRONG. There is no evidence upon that point; only upon articles of clothing. As there seems to be some question about what the evidence was that was given by Professor Zabolotny, perhaps we might ask him to repeat it. I think he gave evidence to the effect that sputum upon the clothing, while moist, might convey infection.

Professor ZABOLOTNY. I should be quite satisfied if the section read simply "there has been no positive *epidemiological* evidence, etc."

This was seconded by Dr. MARTINI and carried *nem. con.*

Dr. ASPLAND. I have been asked to remind the Delegates again that these resolutions are strictly private until after their presentation to the Government.

The CHAIRMAN. The next business before the meeting consists of the

DISCUSSION OF RESOLUTIONS ON SECTIONS D 2, a TO f[1]

Dr. GONZALEZ-FABELLA. I suggest that amendments should not be allowed until the original resolutions have been voted upon. I think that would save a great deal of time.

Resolution 1 [10] was adopted without discussion in the form proposed on the motion of Dr. MARTINI, seconded by Professor ZABOLOTNY.

2 a [11 a]

The acceptance of this resolution was moved by Dr. GRAY and seconded by Dr. MARTINI.

Dr. ASPLAND. From the point of view of being practical, those of us who have had anything to do with quarantine work see a great difficulty in making contacts wear masks. If there are 1,500 to 2,000 contacts, are we to supply each of them with a fresh mask every day?

Dr. GRAY. They do not need to change them every day. Even if they did, it would only mean a strip of gauze every day. It would not be difficult to serve out a bit of gauze to each contact.

Dr. ASPLAND. It is an impracticable recommendation. An enormous staff would be required to serve out the gauze.

Dr. GRAY. It could be served out with the meals. It is a very important thing.

Dr. ASPLAND. You would not get the contacts to wear them except around their necks. They spend the whole time smoking in the cars.

Dr. STRONG. I do not see how you can make contacts wear masks until they have symptoms of the disease.

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[1] These resolutions as originally proposed will be found at the end of the proceedings of this session, on page 383; as finally passed they will be found in the Interim Report on page 391, Nos. [10–16].

The CHAIRMAN. It is very difficult to keep on a mask for two hours. Imagine, then, these men keeping on masks all day and all night. It is most important that suspects and plague cases should wear masks, but I do not think you could make contacts wear them.

Dr. ASPLAND. I have an amendment to make which reads thus:

"Plague patients and suspect cases should wear proper masks."

Dr. MARTINI seconded this proposal, which was carried *nem. con.* [11 a].

2 b [11 b]

Professor ZABOLOTNY. I propose to add "a proper system of death registration, search for cases of sickness and for bodies, in the vicinity of towns and villages, should be established."

Dr. MARTINI seconded this proposal.

Dr. CHRISTIE. Would not one cover the other? It is badly expressed as it stands.

Professor SHIBAYAMA. I think it would be impossible in China. If it is difficult to make a pathological and bacteriological diagnosis in Japan, how much more difficult would it be in China?

Dr. MARTINI. Put in the words "if possible."

Dr. FARRAR. Or "to be verified by bacteriological or pathological diagnosis if practicable."

Professor ZABOLOTNY. I second "if possible."

Professor SHIBAYAMA. That should be inserted between "and" and "pathological."

Dr. STRONG. I think it would be better to leave it as it is. It is quite important to have a complete diagnosis.

The CHAIRMAN. Could we not simply add "whenever possible."

Dr. STRONG. That is understood.

Dr. STANLEY. It is always possible to make a bacteriological diagnosis. It is not always possible to make a pathological diagnosis.

Dr. FARRAR. If one had the staff, one could do both.

Dr. CHRISTIE. It is not merely a question of the staff but also of obtaining the permission of the people.

Dr. MARTINI. I think we might allow "pathological" to drop.

Dr. STRONG. The Chinese Government has done so well this time in regard to necropsies that it ought to carry them on in future.

The CHAIRMAN. I ask you to vote on Dr. Stanley's amendment, "and, when practicable, pathological diagnosis."

Dr. STANLEY. It is always practicable to make a bacteriological diagnosis.

The first sentence of the resolution was adopted as proposed by Dr. STANLEY.

Professor ZABOLOTNY. I understand that house-to-house visitation means that a search for bodies and cases is to be made only in houses. That does not include fields and waste places, where bodies are also to be found. I suggest that it should read "a proper system of death registration and a search for plague cases and bodies in the vicinity of towns and villages should be established."

The CHAIRMAN. I do not know whether the proposal, that a proper system of death registration should be established, is within the scope of our Conference. That is applicable to the whole of China.

Dr. STRONG. It already has been established in Peking.

The CHAIRMAN. For the time being.

Dr. ASPLAND. The introduction to this resolution says "when sporadic cases arise."

Dr. STRONG. Then this is only temporary.

Dr. GRAY. I suggest that the police should be encouraged to trace the cause of death in every case. In ever so many cases in Peking, in which a man died, the police immediately sent for a medical officer and found out whether the man died of consumption, diarrhœa, or some other disease. They found cases of lung trouble where a man had been ill for months. Death registration is a counsel of perfection at present.

The CHAIRMAN. Why the police?

Dr. GRAY. It is all done by the police. That does not touch the central bureau; the police are made use of in every town. All the tracing which has been done hitherto has been done by the police. They were sent out on the surrounding roads, at Changchun, for instance. Whenever a man died in the midst of a town, the police visited his house and made inquiries. In future epidemics it will be the police who will be employed again. They know the people and the streets. They are much more numerous than the sanitary staff could be. And they have done very well when properly directed.

Dr. CHRISTIE. The police always do this kind of work. We have a sanitary staff of a kind and death certification to a certain extent, so that there is a beginning of an organization in Mukden.

Dr. GRAY. It is not a proper system if a bystander comes in and merely reports that such and such a man died of asthma. The proper system is to have a medical man to certify to the cause of death.

Dr. STANLEY. This is simply a question of the number of deaths and not of the cause of death. I think such a system of death registration is absolutely necessary. It is a fundamental principle which could easily be adopted in China. There is no difficulty in getting the number of deaths and where they occurred. This is not a question of the cause of death, but simply provides for the registration of the date and place of death.

Dr. CHRISTIE. Such a system may be easy enough in towns, but not in villages. If it applies to the whole of China, the cities form a very small proportion.

Dr. GRAY. I move "that the police should be encouraged to trace the circumstances and probable cause of every death."

Dr. CHRISTIE. I consider that that is too much dictation as to method. There is a movement to have a proper public health system established.

The CHAIRMAN. How would it do to put in "that a proper system of death registration should, wherever practicable, be established."

Dr. STRONG. I think that is understood.

Dr. GRAY. I withdraw my proposal.

Professor ZABOLOTNY. I want my suggestion for a proper search for bodies included. Registration is one thing and a search for bodies is another.

The CHAIRMAN. You must search for bodies before you can register a proper death rate.

Dr. STANLEY. Perhaps this would be met by deleting "in houses and streets."

Professor ZABOLOTNY. I propose that the following words be added after "death registration:" "and a search for plague cases and corpses in the vicinity of towns and villages is important."

Dr. MARTINI. The Russians found many corpses in the fields. It is very important that brigades should search for corpses in fields and other places.

Dr. CHRISTIE. That takes away the meaning of this sentence altogether. Death registration refers to deaths. Now you pass from that to a specific disease. I think this point would be covered by simply adding "or elsewhere" after "streets."

Professor ZABOLOTNY. Before deaths can be registered, the corpses must be found.

Dr. CHRISTIE. The registration of deaths is a matter quite apart from a plague epidemic.

Professor ZABOLOTNY. During the last few weeks twelve old corpses have been found in the vicinity of Harbin, which would never have been discovered without a search.

Dr. CHRISTIE. I think that this sentence should be placed under No. 1 and not here at all. I think the committee will agree with me when I say it was a mistake on our part that it was not placed at the beginning.

Professor ZABOLOTNY. I wish my proposition to be put to a vote.

The amendment was then put and carried, and became incorporated in the second sentence of 2 b [11 b].

Dr. FARRAR. I think that all will agree that the next sentence beginning "as soon as it shall become practicable" should be added to resolution 1 If we agree to the principle, it really does not matter where the sentence is put, except as a matter of form.

Dr. DI GIURA seconded the adoption of this sentence, with Dr. Farrar's proposal, to put it at the end of resolution 1 [10]. This was carried.

Resolution 2 c [11 c] was carried without discussion.

RESOLUTION 3 a [12 a]

Dr. CHRISTIE. We have used the word "may " here, because it is not always necessary to establish cordons.

This resolution was adopted on the proposal of Dr. MARTINI.

RESOLUTION 3 b [12 b]

Professor ZABOLOTNY. I am of the opinion that in schools, where there is effective control, it is not necessary to carry out the measure of closing them.

Dr. CHRISTIE. I think you must remember that Russia is different from China.

Professor ZABOLOTNY. I propose that the word "schools" should be omitted.

The CHAIRMAN. We are dealing with China, and we can not compare Russian schools with those, for instance, in Chinese villages.

Dr. WORELL. In almost every country the regulations provide for the closing of schools during epidemics of scarlet fever and other diseases. Why not of plague?

Resolution 3 b [12 b] was passed with the addition of the words "market places" after "theaters."

Resolution 3 c [12 c] was carried without discussion.

Dr. GRAY. I think that rickshaw traffic should be under some supervision.

The CHAIRMAN. This resolution is passed. Rickshaws come under disinfection.

Resolution 3 d [12 d] was adopted without comment.

RESOLUTION 4 [13]

Dr. FARRAR. I propose that after the words "easily disinfected" the words "and should be so constructed as to admit of individual isolation" should be inserted.

Dr. STRONG. I second that.

Dr. CHRISTIE. With plague cases it does not matter really how many you have in a room.

Dr. STRONG. Cases other than plague may be admitted into a plague hospital. Cases of tuberculosis and of croupous and of tuberculous pneumonia have been admitted into pneumonic-plague hospitals. They were in Mukden. You can not always prevent such cases from being admitted, but if they entered a plague hospital and were isolated they might not get plague. If I had not seen this occur a number of times in Mukden, I should not feel so strongly about it.

Dr. TEAGUE. You will see that the next resolution provides for hospitals for suspects. These hospitals are to be near the plague hospitals, probably just alongside of them. It is really only a question of terminology, whether you describe the whole thing as a plague hospital. I think we might add to the next resolution the words: "no patients shall be carried from the suspect hospital to the plague hospital until a positive diagnosis has been made."

Dr. STRONG. I agree with that.

Dr. CHRISTIE. Our new suspect hospital is built upon these lines, and no case should be removed from it until certified to be plague.

Dr. STRONG. If you have the two side by side, what is the objection to separating each case in some way, even if you do it by a screen of some kind? It is a bad thing for a patient to be reinfected in any disease. The possibility of plague cases recovering is very small, but they should not be exposed every day to reinfection. We would not treat diphtheria in that way.

The CHAIRMAN. I see that the plague hospital is to be used for other infectious diseases. Can it be used for scarlet fever, say? There are very few partitions in a scarlet fever ward.

Dr. STRONG. Many of the new hospitals have partitions. In Le Sage's clinic for contagious infectious diseases in Paris, for instance, the partitions are only made of cloth, and extend to a height of about three feet above the bed.

Dr. CHRISTIE. This is not dealt with here at all. Provision is made for ample air space and light. I quite agree with Dr. Strong that partitions of some kind are desirable, but not in the case of a general isolation hospital. Provision could be made by which partitions could be put in very easily.

Dr. FARRAR. That is covered by the terms of my amendment.

Dr. CHRISTIE. We have not dealt with details of the construction of a hospital, except that we say it must be rat proof. If you go into detail, there are many other details that should be included, but we only say that ample air space and light must be provided and that the hospital must be rat proof.

Dr. FARRAR. We consider that the isolation of patients is important. Dr. Strong's experience shows how necessary it is to insist upon that point.

Dr. STANLEY. When patients have pneumonic plague, the separation of one from another does not benefit them. When they have it, they die. Why bother to make the hospital two or three times as big as is necessary?

Dr. FARRAR. Wooden partitions or screens could be used.

Dr. STANLEY. That would be merely a matter of furniture.

Dr. FARRAR. I must insist upon the point that individual isolation is necessary.

Dr. CHRISTIE. This is an isolation hospital for general diseases which could be turned into a plague hospital when desired.

The CHAIRMAN. If you insist upon it I will put the resolution with your amendment to the meeting [13].

Dr. FARRAR'S amendment was then put and carried *nem. con.*

RESOLUTION 5 [14]

Dr. GRAY. In resolution 5 [14] I propose that we add, after the word "suspects," the following: "the hospital should be so arranged that each ward is divided into separate cubicles. In order to facilitate supervision, the partition walls could be made of some transparent material, such as muslin."

Dr. STANLEY. Muslin would be insufficient.

Dr. GRAY. Separate rooms require more supervision. In a ward with such cubicles, one man would be able to look after several cases.

Dr. CHRISTIE. Without a substantial partition of some kind, you would find them spitting from one place to another.

Dr. GRAY. My suggestion would be cheaper for the staff and for the building, and it would enable a smaller staff to prevent patients getting up and wandering round the ward.

Dr. GRAY then withdrew his amendment.

Dr. FARRAR. I propose that the word "cubicle" should be used instead of "room."

Dr. WORELL seconded this.

Dr. CHRISTIE. A cubicle is the same thing.

Dr. FARRAR. But the walls do not go to the ceiling.

Dr. CHRISTIE. Then I do not agree with that. The patients might spit over them. These rooms are for suspects, remember.

Dr. TEAGUE. I propose that we should add to this resolution the following sentence:

"No patient should be removed from the suspect hospital to the plague hospital until a positive diagnosis of plague has been made."

Dr. Teague's amendment was put to the meeting and carried *nem. con.* [14].

Dr. FARRAR. I now wish my amendment for "cubicle" instead of "room" put to the meeting.

Dr. ASPLAND. But the walls of a cubicle do not go to the ceiling.

Dr. FARRAR. A cubicle is a partitioned-off space inside a room. The walls do not reach to the top. I know what a cubicle is in schools.

Dr. ASPLAND. When you lived in one, did you not ever climb over the partion? A cubicle often has a curtain in front instead of a door.

Dr. FARRAR'S amendment was then put and lost.

RESOLUTION 6 [15]

Resolution 6 [15] was then put before the meeting for discussion.

Dr. STRONG. I should like to ask one question. Would you not have had a good deal less plague if contacts had been partitioned off from each other?

Dr. ASPLAND. When you are accommodating about 2,000 persons you could never provide for that. We might have had less plague if it had

been possible. But it would be impracticable. With 100 trucks and about 1,600 inmates, we required a staff of about 200. If you had individual houses, it would practically mean a coolie for every cubicle.

Dr. STRONG. If you had another epidemic, would you not consider it better to separate contacts?

Dr. ASPLAND. That would be ideal.

Dr. MARTINI. I suggest that we should add as a separate resolution [16] "The best system would be the cubicle box system."

This was seconded by Professor KITASATO and carried.

DISCUSSION REGARDING PREAMBLE

The CHAIRMAN. Ought there not to be a preamble to these resolutions?

Dr. STRONG. I think that is a matter for the full Conference to decide.

Dr. FARRAR. I think the editorial committee might be left to draft the preamble.

The CHAIRMAN. Is it the wish of the Conference that each delegation should sign by one member, or that every Delegate should sign?

Dr. FARRAR. I think a Delegate appointed by the Delegates of each country.

The CHAIRMAN. I suggest that one Delegate should sign for each delegation.

Dr. GRAY. What was done at the Opium Conference?

The SECRETARY. The chairman, Bishop Brent, signed.

The CHAIRMAN. Can the editorial committee supply us with a preamble by 2 o'clock this afternoon?

Dr. FARRAR read out a draft preamble he had prepared, and it was decided to leave the preamble to the editorial committee with Dr. FARRAR.

The Conference then adjourned until the following morning.

DRAFT RECOMMENDATIONS OF COMMITTEE ON SECTION D 2, a TO f

[Members: Drs. Christie, Zabolotny, Teague, Uyama, and Stanley.]

1. *Need for general sanitary improvement.*

   That a general improvement in the sanitary condition of cities and villages, especially with regard to overcrowding, is desirable.

2. *Isolation and wearing of masks.*

   That when sporadic cases arise, the following measures be put into operation, namely:

   a. Compulsory isolation of plague patients, suspected cases, and contacts; all of whom should wear proper masks.

   b. *Notification and death registration.*

      Notification of sick persons and of dead bodies found in houses or streets by house-to-house visitation, together with bacteriological and pathological diagnosis. A proper system of death registration should be established. As soon as it shall become practicable, death certification and notification of infectious disease by medical practitioners, educated according to modern standards, should be instituted.

   c. *Sanitary education of the people.*

      Education of the public by lectures and the issue of pamphlets and handbills explaining preventive measures in simple language.

3. That, when the disease has assumed epidemic proportions, the following additional measures are desirable, namely:

a. *Sanitary cordons.*

Sanitary cordons may be established, combined with strict medical inspection and quarantine for five days.

b. *Closing of theaters, etc.*

As the aggregation of potentially infective units should, as far as possible, be limited, schools, churches, theaters, etc., should be closed. Inns, tea houses, and night refuges for beggars should be under very close inspection, as they have been shown to furnish most of the cases. Factories should be closed unless arrangements can be made for the employees to live under supervision in or near the factory.

c. *Means of conveyance.*

Tram cars constitute a danger by aggregation of potentially infective units, but rickshaw and cart traffic need not be stopped.

d. *Sectional segregation in communities.*

Where a particular section of a community is alone infected or is more severely infected than another, it is desirable to limit the inhabitants to that particular section and to prevent ingress from other parts of the community, so as to prevent infection; and, in severe epidemics, to divide communities into sections and segregate the inhabitants in each section by the enforcement of quarantine regulations.

4. *Hospitals for plague cases.*

That the need for isolation of pneumonic plague being urgent, permanent isolation hospitals should be available. Such isolation hospitals should be of rat-proof construction, easily disinfected, and should serve the purpose of isolating cases of dangerous infectious diseases generally. In the grounds of such isolation hospitals, should be provided ample space for the construction of additional emergency wards, for which purpose the site should be prepared and foundations laid. The provision of ample air space and light is desirable.

5. *Hospitals for suspects.*

That the hospital accommodation for suspected cases of plague should be adjacent to the hospital for plague cases, and, the need for individual isolation being specially important in order to prevent the infection of noninfected suspects, a separate room should be provided for each patient.

6. *Contact quarantine stations and segregation stations.*

That contact quarantine stations should be so constructed and managed as to secure early detection of cases of plague and, so far as possible, individual separation; and the same principles should apply to the construction and management of segregation stations for certain classes of the community and for immigrants.

SESSION XXIII, APRIL 28

I. Demonstration of lesions of subacute and chronic plague infection and of pneumonic-plague infection in tarbagans.
II. Miscellaneous business.
III. Signing of Interim Report.

Dr. WU took the chair at 10 a. m.

The minutes of the preceding session were confirmed.

Dr. MARTINI then proposed that a demonstration regarding plague infection in tarbagans, made by Dr. Strong and Dr. Teague just before the session, should be included in the records.

Dr. PETRIE. It was exceedingly interesting as showing that the tarbagan can suffer from a chronic form of plague.

The CHAIRMAN. I am sure that the Conference will be glad to hear of this happy termination of our work.

SUBACUTE AND PNEUMONIC PLAGUE INFECTION IN TARBAGANS

Dr. STRONG. Dr. Teague and I are glad to present here a further report upon our first series of experiments performed with tarbagans (*Arctomys bobac* Schreb.). In the first series, six tarbagans were inoculated. Five of these have died of acute plague infection and have already been reported upon. The animal which we wish to show and demonstrate here is the sixth animal of the first series. It was inoculated on April 14. An area over the abdomen was shaved, and a 5-cubic centimeter syringe needle was dipped into a suspension in saline solution of an agar culture of the plague bacillus and thrust beneath the skin. The animal was chloroformed this morning, April 28. As you can see there are small, rather firm areas of necrosis, measuring from 4 to 6 millimeters in diameter, in the subcutaneous tissues near the point of inoculation, and one such area in the anterior portion of the abdominal muscles. The inguinal glands on both sides are swollen, more markedly on the right side. The liver shows numerous yellowish nodules, measuring several millimeters in diameter, and the spleen shows three similar nodules. The lungs are practically normal, with the exception of the upper lobe of the right lung, which shows a hæmorrhagic area measuring about 3 millimeters in diameter. Plague bacilli are

present in small numbers in the abscesses and in the nodules in the spleen and liver. This experiment demonstrates that tarbagans may also suffer with subacute or chronic forms of plague infection. Two other tarbagans of our second series, killed this morning with chloroform, have also shown similar lesions of subacute plague infection with nodules in the spleen and liver. All three of these tarbagans would probably have lived for a considerably longer time.

We also wish to present a brief report upon our experiments in infection of tarbagans by inhalation. Two animals were infected with plague by spraying plague organisms suspended in salt solution into a closed jar. The first animal died three days later. It bit several times at the rather sharp, metal nozzle of the atomizer which was employed in spraying, and probably lacerated the mucous membrane of the mouth. It appears to have died from primary lymphatic infection and secondary septicæmia. The second animal, however, died of primary plague pneumonia. A more complete study of these animals will be reported upon later. [In connection with these experiments see also Part I, p. 237.]

MISCELLANEOUS BUSINESS

Dr. GRAY. I desire to propose one or two votes of thanks before the Conference adjourns. I propose hearty votes of thanks to:

His Excellency Hsi Liang, the viceroy of the Three Eastern Provinces, for his lavish hospitality and for the police and other arrangements made for the comfort and convenience of the Delegates and guests.

To His Excellency Sao Ke Alfred Sze, the Imperial commissioner, for his uniform kindness, unfailing courtesy, and for the assistance he has rendered to the work of the Conference.

To the Chamber of Commerce and the Associated Guilds, for the hospitality extended by them to the Conference.

To the Mukden Club, for according the privileges of membership to the Delegates and guests during their stay in Mukden.

To the secretarial staff, and especially to Dr. Aspland, the medical secretary, Mr. C. H. Lauru, the secretary, and Mr. H. G. W. Woodhead, for the capable and efficient manner in which they have fulfilled their arduous duties.

Dr. CHRISTIE. I have great pleasure in seconding this proposal.

This motion was carried unanimously.

The resolutions comprising the Interim Report were then adopted, as amended, on the proposal of Dr. MARTINI seconded by Dr. GRAY.

The CHAIRMAN. I have here a copy of the Interim Report which is to be presented to the Imperial Commissioner. It is ready for signature by the Delegates representing each nation.

At this final session of the Conference it is my duty to inform

you that this report is to be considered as confidential and is not to be published, but Delegates are at liberty to present it to their respective Governments.

There is one other matter I should like to place before you. I believe that the publication of our full record and other reports will be in the hands of the editorial committee, which has been appointed for that purpose. Are we to understand that when the full proceedings are published the Conference will take full responsibility?

Dr. STRONG. By the rule passed when the editorial committee was appointed, the report was to be left unreservedly in its hands. That, of course, is the only condition upon which the editorial committee could undertake its publication.

Professor GALEOTTI. I move that a vote of thanks be addressed to our Chairman, Dr. Wu, who with such great skill and patience has directed all our sessions. I think all the Delegates will agree with this motion of mine.

The CHAIRMAN. I am very much obliged to the Conference for agreeing with Professor Galeotti's motion of thanks to me. It is I who ought to thank the Delegates for the great kindness and patience extended to the Chair during these four weeks, and not for the Delegates to thank the Chairman. I have nothing more to say except that when we adjourn I hope that you will all have a very pleasant time in Peking, and that we shall always remember with pleasure the four weeks we have spent here in complete harmony. I hope that we shall have happy remembrances of these days.

The Conference then adjourned.

INTERIM REPORT

To the Imperial Commissioner, the Honorable Sao Ke Alfred Sze.

SIR: We, the undersigned, representatives of the delegations to the International Plague Conference, have the honor to present, herewith, this Interim Report, which embodies the conclusions at which we have arrived from the evidence that has been laid before us and the recommendations which we make to the Imperial Government. We have been guided in our deliberations by the principles laid down in your opening address to the Conference, and we trust that our recommendations may prove of service to your Government, should any outbreak occur similar to that which has occasioned the summoning of this Conference.

MUKDEN, *April 28, 1911.*

(Signed)	RICHARD P. STRONG,	*America, U. S. of.*
	EUGEN WORELL,	*Austria Hungary.*
	BROQUET,	*France.*
	MARTINI,	*Germany.*
	G. F. PETRIE,	*Great Britain.*
	GINO GALEOTTI,	*Italy.*
	S. KITASATO,	*Japan.*
	O. GONZALEZ-FABELA,	*Mexico.*
	F. H. HEHEWERTH,	*Netherlands.*
	D. ZABOLOTNY,	*Russia.*
	WU LIEN TEH,	*China.*
	Chairman.	

W. H. GRAHAM ASPLAND,
Medical Secretary.

C. H. LAURU,
Secretary, International Plague Conference.

PROVISIONAL CONCLUSIONS FROM THE EVIDENCE SUBMITTED TO THE CONFERENCE

1. From northern Mongolia the epidemic followed a clearly defined course eastward and southward, its diffusion having been principally determined by routes of travel, especially railways, roads, and shipping. The disease spread by direct in-

fection from man to man, and whatever may have been its primary origin, there is no evidence that a concurrent epizoötic in rodents played any part in its general dissemination.

2. The chief factor in the decline of the epidemic has probably been the preventive measures which were enforced, either in accordance with scientific methods or by the crude efforts of the people to protect themselves. Climatic influences may have contributed indirectly, or even directly, toward bringing the epidemic to an end, but the evidence presented on these points is inconclusive. The decline has not been due to any loss of virulence of the bacillus.

3. Infection was introduced into towns and villages by persons actually suffering from plague or by those in the incubation stage of the disease.

4. There has been no positive epidemiological evidence to show that infection has been spread by clothing, merchandise, or other inanimate objects.

5. Overcrowding has undoubtedly contributed to the spread of the disease within houses by multiplying the chances of infection.

6. The epidemic has been, almost without exception, one of primary pneumonic plague. The incubation period varies as a rule from two to five days. A rise in temperature and an increased pulse rate are usually the earliest symptoms observable, but a diagnosis can not be made, until the specific bacilli have been recognized in the sputum, or until the sputum has become characteristically blood stained. An accurate diagnosis can be made only by a bacteriological examination of the sputum, with the view of excluding pneumonic infections due to other microörganisms. Since the evidence points to the conclusion that in the past epidemic all the cases became septicæmic, an examination of the blood, microscopically or culturally, may be a valuable aid in diagnosis.

The physical signs of lung involvement are frequently too indefinite, and appear too late in the course of the disease to be of great diagnostic value, and, even in cases in which the condition of the patient is grave, they may be very slight.

7. The fatality of the disease during the past epidemic has been extremely high, scarcely any cases of recovery having been reported.

8. The general experience has been that no method of treatment has been of any avail in saving life, but the serum treatment seems, in a few instances, to have prolonged the duration of the illness, and even one or two cases of cure have been attributed to its use.

9. The strain of bacillus, isolated during the past epidemic, has differed in no essential respect from the strains of *Bacillus pestis* previously isolated from other sources.

10. So far as can be ascertained, the only infective agent in the epidemic has been the sputum of the plague patient. In the majority of cases the disease has been contracted by the inhalation of plague bacilli in droplets of sputum, causing infection of the lower portion of the trachea and the bronchi.

11. In the case of infection by inhalation, the risk to the person exposed bears a direct relation to his proximity to the patient and the duration of exposure.

RESOLUTIONS

1. The past epidemic arose in a region which has been associated for years with outbreaks of pneumonic and bubonic plague, but sufficient evidence is not forthcoming with regard to its precise origin.

2. From Russian medical sources it has been reported that an epizoötic disease exists among tarbagans and that it is not unlikely that this disease is plague, but that it is plague has never yet been proved bacteriologically.[1]

3. There is no definite evidence to show that the first cases of this epidemic were caused by infection from sick tarbagans. Nevertheless, there is strong presumption for believing that tarbagan disease is closely associated with pneumonic plague in Manchuria, trans-Baikalia, and northeast Mongolia, and, therefore, with the recent outbreak.

4. Systematic investigations should be made as to whether epizoötic disease occurs among tarbagans and other rodents, and, if such exists, an accurate investigation should be made of the nature of the infection.

5. Such investigations should be made under the direction of someone who has had special experience in the examination of rodents for plague infection; and the investigation should include the complete anatomical and bacteriological examination of these animals, with the careful identification of any organisms encountered.

6. Provision should be made for the discovery of disease among these rodents and for their early transmission to the investigators.

7. The two countries principally interested (China and Russia) should separately assume responsibility for carrying out such investigations.

8. Arrangements should be made for bringing the tarbagan-

[1] See footnote Part I, page 192.—[EDITOR.]

trapping community in Manchouli district under a system of medical supervision, particularly during the trapping season, and a segregation station and hospital should be established at the headquarters of this community.

9. The question of the occurrence of pneumonic plague in mules, donkeys, and dogs should be made the subject of special study with regard to their liability to this infection. Although instances of this disease in these animals have been reported, the subject needs further study.[1]

10. A general improvement in the sanitary condition of cities and villages, especially with regard to overcrowding, is desirable. As soon as it shall become practicable, death certification and notification of infectious disease by medical practitioners, educated according to modern standards, should be instituted.

11. When sporadic cases of pneumonic plague arise, the following measures should be put into operation, namely:

a. Compulsory isolation of plague patients, suspected cases, and contacts; plague patients and suspect cases should wear proper masks.

b. Notification of sick persons and of dead bodies found in houses or streets by house-to-house visitation. Bacteriological and, when practicable, pathological diagnosis should be made. A proper system of death registration should be established. A search for plague cases and corpses in the vicinity of towns and villages is important.

c. Education of the public by lectures and the issue of pamphlets and handbills, explaining preventive measures in simple language.

12. When the disease has assumed epidemic proportions, the following additional measures are desirable, namely:

a. The establishment of sanitary cordons, when desirable, combined with strict medical inspection and quarantine for five days.

b. As the aggregation of potentially infective units should, as far as possible, be limited, schools, churches, theaters, market places, etc., should be closed. Inns, tea houses, and night refuges for beggars should be under very close inspection, as they have been shown to furnish most of the cases. Factories should be closed, unless arrangements can be made for the employees to live under supervision in or near the factory.

c. Tram cars constitute a danger by bringing about an aggregation of potentially infective units, but rickshaw and cart traffic need not be stopped.

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[1] See footnote Part I, page 62, also Part III, page 440.—[EDITOR.]

d. Where a particular section of a community is alone infected, or is more severely infected than another, it is desirable to restrict the inhabitants to that particular section, and to prevent ingress from other parts of the community, so as to limit infection, and, in very severe epidemics, to divide communities into sections, to segregate the inhabitants in each section, and to enforce quarantine regulations.

13. The need for isolation of pneumonic-plague patients being urgent, permanent isolation hospitals should be available. Such isolation hospitals should admit of individual isolation, be of rat-proof construction, and be capable of easy disinfection. In the grounds of such isolation hospitals ample space should be provided for the construction of additional emergency wards, for which purpose the site should be prepared and foundations laid. The provision of ample air space and light is desirable.

14. The hospital accommodation for suspected cases of plague should be adjacent to the hospital for plague cases, and the need for individual isolation being specially important, in order to prevent the infection of noninfected suspects, a separate room should be provided for each patient. No patient should be transferred from the suspect hospital to the plague hospital until a positive diagnosis of plague has been made.

15. Contact quarantine stations should be so constructed and managed as to secure early detection of cases of plague and, as far as possible, individual separation; and the same principles should apply to the construction and management of segregation stations for certain classes of the community and for immigrants.

16. The best system would be the cubicle box system.

17. Clothing and bedding of the patient should be thoroughly disinfected by steam, boiling, or prolonged soaking in a disinfectant solution. If of no value, they should be burnt.

Clothing and bedding of contacts should be disinfected by steam, or by boiling, or by spraying thoroughly with a disinfectant. Articles that would be spoiled by such treatment may be disinfected with formalin vapor or dried by dry heat and exposed to the sun for three days; the whole surface must be exposed in turn.

18. Houses must be disinfected in the following manner:

They should be sealed up for a few hours immediately after removal of the patient or the corpse.

Search should be made with a good light for visible contamination with blood, sputum, etc. Such contaminated matter must be forthwith disinfected, or removed and burnt.

The house must then be sprayed and swabbed with a dis-

infectant solution. Slaked lime may be spread evenly on a mud floor. When a house can be rendered air-tight, fumigation with formalin may be employed.

Cars may be disinfected in the same way as houses, or by steam.

The disinfection of furniture may be included in that of the house, or be carried out by fumigation and exposure to sun. The spittoon must be thoroughly disinfected. The *k'ang*-mat and all rubbish should be burnt.

House burning should not be carried out where it is found reasonably possible to disinfect.

19. Articles of trade, except rags and old clothes, need not be disinfected, unless they are known to have been exposed to infection.

20. For the disinfection of sputum, carbolic acid, if possible with soap or alkaline coal-tar products (cresols), is recommended. Many satisfactory preparations of cresols are sold under special names, but no proprietary disinfectant should be adopted until its potency and properties have been scientifically investigated.

Other useful disinfectants are chloride of lime, slaked lime, formalin, and perchloride of mercury (the last not to be employed for sputum).

21. To make these measures of disinfection effective, it is of the utmost importance that there should be a sufficiently large body of trained men to carry them out; and the best method of securing this object is to set up in every provincial capital a permanent establishment and disinfecting staff.

22. Plague corpses, when found, should be wrapped in coarse sheets soaked in sublimate solution, and removed in special metal-lined, covered carts provided for this purpose.

The burial staff should be provided with blunt, iron hooks to facilitate the removal of corpses.

In view of the length of time during which plague corpses may remain infective, the quickest, safest, and most economical method for their disposal is complete cremation with wood and kerosene oil in special pits prepared for the purpose and situated at a convenient distance from the town or village affected.

23. There should be in each administrative district a permanent nucleus, consisting of a medical and sanitary staff, capable of rapid expansion, ready for dealing with any outbreak of plague that may occur.

So far as possible, a uniform system of sanitary administration should be prescribed for all districts.

The quarters for the sanitary staff should be isolated under the best practicable conditions.

24. Until further statistics are available, the sanitary staff should be inoculated, as far as practicable, with plague vaccine before commencing their duties.

At the same time, in view of the special danger of infection by inhalation that has been manifest during the past epidemic, the sanitary staff should be provided with masks of uniform pattern and instructed in their proper use.

The best form of mask [1] is a simple, three-tailed, gauze and cotton-wool pad, which should be destroyed, or disinfected, after each tour of duty.

The sanitary staff should also be provided with gloves and overalls, which should be of impermeable material, and those in immediate contact with the patients should wear goggles in addition to the above.

On coming off duty, each member of the staff should take a bath, and his working clothes should be disinfected at the sanitary station.

The sanitary staff should be medically inspected, and their temperatures taken twice daily.

25. The statistical evidence points to the conclusion that some degree of protection is conferred against bubonic plague by the use of vaccines.

26. Therefore, there are *a priori* grounds for the use of inoculation with vaccines as a means of protection against pneumonic plague.

27. The statistics which have been collected during this past epidemic do not allow us to come to any definite conclusion about the value of active prophylactic inoculation against plague pneumonia.

28. Many methods proposed for producing immunity against

[1] While this form of mask appeared during the epidemic to be efficacious in preventing the wearer from contracting pneumonic-plague infection from a pneumonic-plague patient, it has been recently found by Teague, Barber, and the writer that, when *Bacillus prodigiosus* is suspended in salt solution and is sprayed in the neighborhood of a person wearing this type of mask, if the spray is fine, the organism passes through or around the edges of the mask and may be recovered from the saliva of the individual wearing it. It is, therefore, not bacteria-proof. It appears that, while the gauze and cotton comprising the mask may intercept the bacteria in droplets of sputum emitted—for example, by the cough of pneumonic-plague patients—if the bacilli are suspended in a fine vapor, they penetrate in some way, either around the edges or through the mask. For a complete report of these experiments, see article in *Phil. Journ. Sci.* now in press.—[EDITOR.]

plague have been considered by this Conference; of these some already have been used largely on human beings; others are still under trial.

a. *Those already largely used are:*
   (1) Dead bacilli vaccines (*a*) Bouillon cultures.
   (*b*) Agar cultures.
   (2) Nucleoproteid vaccines.
   (3) Mixed dead bacilli and serum combined.

b. *Those under trial:*
   (1) Living attenuated cultures.
   (2) Living cultures and serum combined.

29. Dead bacillary vaccines can be simply prepared, and, in one form or another, have been extensively used in different parts of the world. There is a considerable amount of evidence to the effect that preparations of this kind can confer some degree of protection against bubonic plague, and the method of agar culture affords some advantage in respect to quickness of preparation, and it is the opinion of the majority of this Conference that killed cultures represent at the present time the simplest, safest, and best method of vaccination against plague, and this opinion is expressed without prejudice to the use of other methods of vaccination or vaccination combined with serum-prophylactic, should such be proved to offer greater advantage.

30. *Lustig and Galeotti's vaccine.*—This preparation seems to have given excellent results experimentally on animals and can be as safely used as other vaccines. It has the advantage that, without losing its properties, it can be conveniently stored in a dried form.

31. *Strong's method.*—This is worthy of careful consideration. The results obtained by experiments on animals and on human beings are so striking as to make it important to collect more evidence as to the safety of the method as a practical prophylactic on a large scale.

32. We offer the following advice:

a. That experiments on animals (guinea pigs, white rats, and monkeys) should be carried on by the method of inhalation, in order to find out which vaccine can be best used against pneumonic plague.[1]

b. That, should another outbreak of pneumonic plague occur, the above methods of vaccination should be tried in selected communities (as in India) under rigorous scientific conditions.

[1] See Part III, p. 450.—[Editor.]

33. Concerted action between the different railway companies of Manchuria and north China should be promoted, so as to bring about a uniform system of sanitary defense on all railway lines. With this object, a joint railway medical board for quarantine and sanitary purposes only, having a central office, should be formed by the railway companies concerned to frame regulations for the control of traffic in times of epidemic prevalence of plague or other diseases.

34. There is evidence before the Conference of want of uniformity in the action of different port authorities in respect of quarantine measures, and there are grounds for believing that in some instances the stringency or otherwise of quarantine measures in ports is left to the individual initiative of medical officers in different ports. So far as may be practicable, a uniform international system of port sanitary administration and quarantine for north China should be brought about by coöperation between the Imperial Government of China and the other nations concerned. Such administration should follow the lines of the Convention of Paris, 1903, so far as they are applicable.

35. With a view to systematizing in epidemic periods the control of traffic both by land and sea, the above-named joint railway medical board should, so far as may be practicable, act in concert with the above-named international port sanitary service.

36. To facilitate the control of coolie traffic by land and sea, inducements should be offered to traveling coolies to journey by rail and by recognized steamer lines, and the regulations devised should be such as to combine the maximum of efficacy in respect of controlling the spread of disease with the minimum of restriction of travel.

37. In times of epidemic prevalence of plague, there should be supervision of travelers by road and of cart traffic by the magistrates and officials of towns and villages in the affected districts, together with inspection and supervision of inns, poorhouses, etc. Travelers by road should be furnished with sanitary passes, which must be indorsed at the yamens of the places through which they pass.

38. In view of the fact that coolies and other travelers are known to land from junks and open boats at points along the coast line other than the recognized ports, there should be closer sanitary supervision than heretofore of the coast line of the Gulf of Pechihli in time of plague, and there should also be sanitary supervision of traffic on rivers.

39. The evidence before the Conference is to the effect that

it is unnecessary and undesirable in respect of pneumonic plague to restrict the transit of goods (other then personal luggage) and of mails.

Should there be evidence at any subsequent time of an epizoötic in rats, it would become necessary to take measures to secure the destruction of rats on ships and in ports and to guard against the passage of rats from shore to ships or from ships to shore. In this event it might also become necessary to frame special regulations in respect of cargoes containing grain or other cargoes likely to attract rats.

40. In time of plague, the carriage or shipment of corpses should be prohibited.

41. A plague code should be forthwith drawn up, embodying complete regulations and instructions to all officials concerned, applicable on the outbreak of plague.

42. A permanent sanitary nucleus should be formed, capable of rapid expansion in time of plague, and a list should be drawn up of medical officers who could be sent immediately to the affected area on the outbreak of plague.

43. Means should be devised to instruct the public that plague regulations are made in the public interest and for the protection of the whole people.

44. With the view of giving effect to these recommendations, every endeavor should be made to organize a central public health department, more especially with regard to the management and notification of future outbreaks of infectious diseases.

45. In furtherance of the above purposes, every effort should be made to secure effective medical education in China.

CLOSING CEREMONY, APRIL 28

I. Reception and address by His Excellency the Viceroy, Hsi Liang.
II. Presentation of the Interim Report by the representative of the Delegates, Dr. Hehewerth.
III. Reply of the Imperial Commissioner, the Hon. Sao Ke Alfred Sze.
IV. Closing remarks by the Chairman, Dr. Wu Lien Teh.

The closing ceremony of the International Plague Conference took place at 4 p. m. on Friday, April 28, 1911.

Dr. WU, the chairman of the Conference, called upon Dr. Aspland, the medical secretary, to read the following telegrams:

[Telegram from the Waiwupu, Peking, addressed to Commissioner Sze.]

Please convey to the members of the International Plague Conference expressions of our deep appreciation and thanks for the successful termination of their deliberations which, we feel confident, will throw much light upon the epidemic, both from a scientific standpoint and in regard to methods of prevention, and will thus result in blessings to mankind.

[Telegram from the Minchengpu addressed to the International Plague Conference.]

The Minchengpu send their cordial greetings to the members of the International Plague Conference and congratulate them upon the successful termination of their important work.

[Telegram from the Governor of Shantung addressed to Commissioner Sze.]

It is most fortunate for us that the experts of the different nations should have assembled together for the purpose of studying plague-preventive measures, which must mean the better protection of the lives of our people. Although we may congratulate ourselves that plague has been eradicated from the Three Eastern Provinces, from Chihli, and Shantung, we trust that the inhabitants of these five provinces will not forget the lessons learned from the epidemic, but will endeavor to improve the sanitation and hygiene of their homes, so that plague will be unable to recur in the future. By so doing, they will crown the labors of the Conference. To the Delegates, I extend my hearty thanks, at the same time wishing them good health and prosperity.

[Telegram from Governor Chen of Kirin addressed to the International Plague Conference.]

We feel grateful to you gentlemen who have come such a distance to Manchuria to make a thorough study of the epidemic. We feel sure that in your conclusions you will throw much light upon the disease, thus not only relieving the sufferings of the people but benefiting the whole of mankind. I respectfully send you this message of congratulation upon the eve of your closing.

[Telegram from Baron Goto, minister of Communications, Tokyo, addressed to the International Plague Conference.]

Accept sincere thanks for the valuable service rendered by the Delegates of several nations for the cause of humanity and profound congratulations for perfect success.

ADDRESS BY HIS EXCELLENCY THE VICEROY, HSI LIANG

Honorable Delegates, Ladies, and Gentlemen, we have met to-day on a very auspicious occasion. It is the last day of the four weeks of sessions of the International Plague Conference, and I can not adequately thank you for the extreme care you have taken in your deliberations and the dignity you have conferred upon the Conference by your daily attendance. The world, and certainly this Empire, will, I doubt not, benefit largely as the result of your invaluable services.

One of our great poets describes the memory of good deeds as not only engraven in the heart, never to be forgotten, but also as causing the people to sing with health and happiness (*ming kou k'an lo, ying shih fu hsuan*), and the knowledge of this, I can assure you, will not be the least of your rewards.

You have shown in your endeavor to preserve the life and health of the people what mankind has been slow to learn, namely, that necessity makes brothers of us all.

I heartily wish you every success in the further elucidation of some of the more obscure problems of the past epidemic which you have in hand, and trust that ere long these will contribute still more to the health and happiness of mankind. Finally, may I wish you a safe and pleasant voyage home to the several countries which have sent you on this noble mission.

PRESENTATION OF THE INTERIM REPORT

BY DR. HEHEWERTH [1]

I am very much honored in being called upon to-day to speak in behalf of the Delegates of the International Plague Conference and to deliver their Interim Report to the representative of the Imperial Government.

At the moment when China was the victim of plague pneumonia, of this terrible disease which had spared the people of the world for so many years, the Chinese Government not only did everything which was possible for her to check the scourge which was destroying so many precious lives, but also conceived the remarkable idea of requesting the various Governments to

[1] Dr. Hehewerth delivered his remarks in French, the translation of which follows.—[EDITOR.]

send delegates to Mukden to study the disease. By this action she found the means to add to her own power, the experience and results, obtained by long years of scientific investigation, of the most eminent scientists of the whole world, and to combat the pitiless and fatal common enemy by laws of human fellowship and of philanthropy.

For about four weeks we have studied in Mukden the means of attack and of defense against a pathogenic organism, the harmful action of which seems actually extinct but the awakening of which China and all humanity should fear at any moment. To study the questions which have been submitted to us in all their phases and in the most minute particulars, we borrowed both from the experiences of the past and from the recent experiences related to us by Chinese and other doctors who had passed through this epidemic.

The result of these studies is embodied in the Interim Report which we herewith present to you. In it you will find our conclusions and our resolutions. We hope and believe that if China again finds herself confronted by an epidemic similar to the one which has brought us here, she will be able, inspired by the resolutions of this Conference, if not to forestall entirely the outbreak, at least to arrest it at the beginning, as has been done in other countries.

Excellency, in expressing this hope, I submit the result of our work through you, as exalted intermediary, to the Chinese Government, which has honored us by calling us in consultation, and I beg of you to receive it favorably, and kindly to convey to your Government our thanks and our gratitude for the hospitality which you have offered us in the city of Mukden and for the solicitous attention which you did not cease to lavish upon us. Thus you rendered our task easy, and you will permit us to attribute to you a large portion of the success of the Conference.

REPLY OF THE IMPERIAL COMMISSIONER

The Hon. SAO KE ALFRED SZE

Gentlemen, on this, the last session of the Plague Conference, it is my pleasant duty to receive from you a copy of the fruits of your labors for transmission to my Government.

Though I have taken no part in your deliberations, I have been living among you since we first met here, and I have, therefore, no difficulty in expressing my feelings regarding the admirable and thorough way in which you have worked to elucidate the many problems of pneumonic plague as presented in the recent epidemic.

Let us be under no cloud, gentlemen. Your deliberations have shown us that there is still much to be learned, still much work to be done before we can master all the difficulties attached to this perplexing subject, and my Government will appreciate the fact that, while a big step forward has been taken, there still remains an unknown land which has yet to be penetrated. I refer particularly to the unsolved questions as to the original causation of the epidemic and the treatment of infected persons. For the rest, you are greatly to be congratulated in having shown us the way in which the plague germ acts on man, the manner in which infection is incurred, and the means by which such infection from man to man can be prevented.

A mass of evidence has been collected which will be useful for future guidance and which, I can assure you, will receive the full attention of the Imperial Government.

I am glad that you have found that we did our best in the various districts when once we had grasped the seriousness of the epidemic.

The labors of the editorial committee in arranging all the scientific data will not be light, but I am sure you will agree with me that when the final report appears it will be found that the Conference has more than justified itself and that not only China but the world at large will be put in possession of valuable information on the subject of pneumonic-plague epidemics, which has hitherto been lacking in medical records.

And, let me add, if this new-found knowledge enables us to cut short another epidemic of a similar nature, we will view with the utmost satisfaction the course my Government has taken in appealing to the nations you represent for the able aid you have so generously given us.

It would be superfluous on my part, where all have done so well, to single out any special name, but I hope you will allow me to refer with appreciation to the splendid help that has been given to the Conference by Professor Kitasato and his Japanese colleagues, and to the valuable researches carried out and set forth in such clear detail by Dr. Strong and Dr. Teague during their sojourn in Mukden. The Russian doctors, headed by that renowned scientist Professor Zabolotny, have also assisted us considerably by giving us their valuable experience in antiplague work.

May I be permitted to express the great pleasure it has given me in making your acquaintances and also my deep satisfaction in having the good fortune to be associated with this, the first international scientific conference that has been held in the

Chinese Empire, and which is also the first international pneumonic-plague conference in the history of the world.

Gentlemen, in closing these few remarks, allow me once more to thank you, one and all, for your kindness in coming here and for all that you have done to help us.

The thanks of all of us are also due to the president, Dr. Wu, the medical secretary, Dr. Aspland, the secretary, Mr. Lauru, the official stenographer, Mr. Woodhead, and the other members of the secretarial staff for the industrious and efficient way in which they have carried through all the work connected with the sessions of the Conference.

CLOSING REMARKS

By Dr. WU LIEN TEH

Your Excellencies, Delegates, Ladies, and Gentlemen, before the proceedings of this Conference are closed, may I be permitted, as chairman, to say a few words. All through the sessions the discussions have been very complete, and sometimes diversity of opinion has been expressed on subjects of scientific interest, but so far as I can remember—and I have been present at all the meetings—there has always existed the best of relations among the distinguished Delegates who took part in the sessions. This can only be accounted for by the desire of every one to make the Conference a great success, and I can not thank you enough for the attention you have paid to all the deliberations. That many interesting observations and important data have been gathered, admits, I think, of little doubt, and it is my earnest hope that future researches which will be carried out by you will clear up certain points which at present may seem obscure.

Finally, will you allow me to take this opportunity of thanking you for your unfailing courtesy and also for your kindness to me in my capacity as president.

APPENDIX[1]

SOME EXPERIMENTS IN THE AGGLUTINATION OF THE ORGANISM OF PNEUMONIC PLAGUE[2]

By Dr. E. SIGNORELLI

The following experiments were made with two objects in view:

First, to find out whether agglutinins are formed in the blood of human beings vaccinated against plague by two different methods.

Secondly, to establish if the organism, isolated from patients suffering with pneumonic plague in Manchuria, would be agglutinated by sera prepared with plague antigen of different origin.

The usual technique of the agglutination test was followed. I used suspensions in physiological salt solution of forty-eight-hour agar-agar cultures. To these suspensions accurately measured quantities of diluted serum were added, and the test tubes allowed to remain for two hours in the incubator. The plague culture was kindly supplied to me by Dr. Hill, who obtained it from a patient with pneumonic plague at Fuchiatien.

In the following tables the results of the agglutination tests are indicated as is usual with + and − signs, the + signs indicating the degree of agglutination, the − sign, no agglutination.

A

Agglutination properties of the blood of vaccinated individuals.

1. Vaccinations by Lustig and Galeotti's method.

Professor Galeotti's and my own blood-serum were collected one month after inoculation with plague nucleoproteid, prepared at the Serum Therapeutic Institute in Berne. The doses inoculated were: 0.002 gram the first time, 0.003 gram the second, and 0.003 gram the third time. After the first two inoculations there was a considerable general and local reaction; after the third one the reaction was almost nil.

The blood was extracted from the vein by means of a syringe, and was diluted with physiological salt solution in various quantities. The mixture was allowed to remain in a cold place until a perfectly clear and colorless liquid was obtained; this was then mixed with the suspension of the plague bacillus.

[1] The report of these experiments was not received until May 4, after the close of the Conference. Unfortunately there was no opportunity for the Conference to discuss them.—[EDITOR.]

[2] These researches were carried out at one of the laboratories of the International Plague Conference at Mukden.

The results are expressed in the following tables:

	Dilution.			
	1:25	1:50	1:100	1:150
Galeotti's serum:				
After one hour		—	—	—
After two hours	+++	++	—	—
Signorelli's serum:				
After one hour	+++	++	—	—
After two hours	+++	+++	++	—

2. Vaccination by the mixed method, viz; Haffkine's lymph and Russian antiplague serum.

Dr. Paul Haffkine was vaccinated by this method, and he kindly allowed me to collect his serum.

The result of the agglutination experiments with this serum was as follows:

	Dilution.			
	1:25	1:50	1:100	1:150
After one hour	—	—	—	—
After two hours	++	—	—	—

3. In a control experiment performed with the serum of a normal Chinese boy, the result was as follows:

	Dilution.			
	1:25	1:50	1:100	1:150
After one hour	—	—	—	—
After two hours	—	—	—	—

B.

The agglutination of a pneumonic-plague organism, isolated at Fuchiatien by antiplague sera of different origin, was also tested with:

1. Dried serum prepared at Kronstadt with a strain of the plague bacillus which was isolated in a bubonic epidemic and kindly supplied by Professor Zabolotny.

One tenth gram of this serum was dissolved in 10 cubic centimeters of physiological saline solution and diluted further as follows.

Results

	Dilution.								
	1:20	1:30	1:50	1:80	1:100	1:120	1:150	1:220	1:250
After one hour	+++	+++	+++	++	—	—	—	—	—
After two hours	+++	+++	+++	++	+++	++	+++	++	—

2. Serum of rabbits vaccinated with nucleoproteid prepared at the Serum Therapeutic Institute in Berne.

In a period of three weeks, three inoculations were made with 0.001 gram of nucleoproteid each.

Results

	Dilution.								
	1:20	1:30	1:50	1:80	1:100	1:120	1:150	1:220	1:250
FIRST RABBIT									
After one hour	+++	+++	+++	++	+	—	—	—	—
After two hours	+++	+++	+++	+++	+++	+++	++	++	—
SECOND RABBIT									
After one hour	+++	+++	++	—	—	—	—	—	—
After two hours	+++	+++	+++	+++	+++	+++	+++	+++	—

3. Serum of a rabbit inoculated with a suspension of dead bacilli of a pneumonic-plague agar culture, isolated at Fuchiatien, and the suspension prepared according to the method of the German Commission. The rabbit was inoculated three times with 0.5 cubic centimeter on each occasion.

Results

	Dilution.								
	1:20	1:30	1:50	1:80	1:100	1:120	1:150	1:220	1:250
After one hour	++	—	—	—	—	—	—	—	—
After two hours	+++	+++	+++	+++	+++	+++	—	—	—

4. Control experiment with the serum of a normal rabbit:

	Dilution.				
	1:20	1:50	1:100	1:150	1:200
After one hour	—	—	—	—	—
After two hours	—	—	—	—	—

The results of these experiments can be summarized as follows:

1. The serum of human beings vaccinated against plague may possess agglutinative properties. These properties are stronger if the Lustig-Galeotti method has been employed in the inoculation.

2. The serum prepared with strains of bubonic-plague bacilli agglutinate, even in high dilution, the organism isolated from a case of pneumonic plague at Fuchiatien, and, therefore, we can conclude that no difference exists between the bubonic and pneumonic strains of the plague bacillus.

PART III

SUMMARY OF KNOWLEDGE GAINED FROM THE STUDY OF THE EPIDEMIC

CHAPTER I

AN EPIDEMIOLOGICAL REVIEW OF THE EPIDEMIC OF PNEUMONIC PLAGUE IN NORTHERN CHINA, 1910 TO 1911 [1]

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[1] While this review is based mainly on the proceedings of the epidemiological section of the Conference, I have consulted in the course of its preparation the publications given below, which have proved valuable in making clear certain phases of the epidemic. Information from these sources has on occasion been incorporated. I am further much indebted to Dr. Wu Lien Teh, Dr. G. Douglas Gray, Dr. Christie, Dr. Hill, and Dr. Score Browne for kindly sending me supplementary reports after the Conference ended.

A report on the septicæmic and pneumonic plague outbreak in Manchuria and northern China (autumn, 1901, to spring, 1911), by G. Douglas Gray, M. D., Edin., physician, H. B. M. Legation, Peking. *Lancet*, London (1911) I, 1152.

Letters in *The Times*, London (March 22 and 23, 1911), on the origin of the epidemic and on the outbreak in Fuchiatien, written by Dr. G. E. Morrison, Peking.

Manchuria: Its people, resources, and recent history, by Alexander Hosie, M. A., F. R. G. S., London, 1904.

The Provinces of China, being *The National Review Annual*, 1910. Shanghai, 1910.

The relation of animal plague to the epidemic.
Discussion of certain possible modes of transmission of the infection.
Direct infection from man to man.
Indirect infection from human sources:
Gross deposited infection (sputum) on clothing, merchandise, *k'angs*, floors, etc.
Ultravisible infection of inanimate objects.
Discussion of the causes of the decline of the epidemic.
Summary of conclusions.

INTRODUCTION

From an epidemiological standpoint, the severe visitation of pneumonic plague, which overran the northern provinces of China during the winter of 1910 to 1911, presents several features of peculiar interest. Historical records of plague and certainly contemporary records, dating from the discovery of *Bacillus pestis* in 1894, furnish no instances of an epidemic similar in type and equal in magnitude to the Manchurian outbreak.

While in many epidemics of bubonic plague, especially in temperate regions, a small proportion of the cases have been pneumonic, sometimes even the pneumonic type predominating, this epidemic, so far as can be ascertained, was from beginning to end of a purely pneumonic character. The study in many parts of the world of the present pandemic of plague has impressed epidemiologists with the overwhelming and almost exclusive importance of rat plague in the causation of the bubonic and septicæmic forms of human plague. This impression has not been weakened by the knowledge that in Siberia and Mongolia outbreaks, apparently of a mixed type, have occurred for many years associated with an epizoötic disease in the tarbagan. The fact that the epidemic in Manchuria, with a death roll of 50,000 persons and a track, including ramifications, of at least 3,000 miles, has owed nothing in its origin or dissemination to rat plague, must appeal with challenging interest to those who have had experience only of the interrelation of rat and human plague.

Although China does not appear to have suffered in the past from pneumonic-plague outbreaks, bubonic plague within the confines of the Empire, associated with rat epizoötics, has long been prevalent. The southern province of Yünnan has for many years been known as an epidemic focus and is probably to be regarded as the starting point of the present pandemic. Canton, Hongkong, Pakhoi, Swatow, Foochow, and other towns on the coast are centers of the disease. Hankow was attacked in the autumn of 1908, but the small outbreak here was circumscribed

and abortive. In Shanghai, plague-infected rats were first discovered in December, 1908, and the infection still persists among the rat population, although fortunately not accompanied by any serious manifestation of human plague. Within recent years southern Manchuria has been visited by two epidemics. The one originating from Hongkong broke out in Newchwang in 1899 and spread to the adjoining districts of the Liaotung Peninsula. The disease was chiefly of the bubonic type and lingered for several years, accounting for a considerable number of deaths. In the other, the infection was imported by workmen from Canton into Tongshan, whence it spread to the surrounding villages with the result that a short but severe outbreak of about 1,000 cases occurred.

Before proceeding to discuss in detail the epidemiological features of the Manchurian epidemic, it may be noted that the epidemiology of pneumonic plague is altogether different from that of bubonic plague, and that indeed in this regard the two forms have nothing whatever in common, except that they are caused by the same microörganism. Whereas the bubonic form is not a contagious disease, pneumonic plague is a typical example of a disease spread by direct contagion. The dictum "The plague hospital is the safest place in a bubonic epidemic" requires revision into "The plague hospital is the most dangerous place in an epidemic of pneumonic plague." When one considers the complicated factors which combine to bring about a bubonic epidemic, it is apparent that the epidemiology of pneumonic plague is essentially a simpler problem.

THE ORIGIN OF THE EPIDEMIC

Data relating to the precise origin of the epidemic are unfortunately lacking. Nevertheless it must be admitted that a mass of collateral evidence exists, on which a reasonably certain account may be based. It will be convenient first of all to narrate the facts which are beyond dispute.

The first serious outbreak declared itself on the 13th of October, 1910, in the town of Manchouli. This town is the western terminus of the Chinese Eastern Railway—the extension in Manchuria of the Trans-Siberian Railway—and is situated about 10 miles to the east of the Sino-Siberian boundary and about 530 miles northwest of Harbin. The normal population consists of 5,000 Russians and 2,000 Chinese, but, owing to an invasion of Chinese hunters, during the tarbagan-hunting season, the latter number is increased to 10,000. Three hundred and ninety-two deaths from pneumonic plague occurred, with few exceptions,

among the Chinese, and the last case was reported on the 25th of December.

From Manchouli the infection streamed eastward and southward throughout Manchuria, until it penetrated as far as the provinces of Chihli and Shantung.

The question of the source of infection in Manchouli is a difficult one. It has been supposed that the plague was introduced by a tarbagan trapper on his return from the chase. On the other hand, evidence has been brought forward indicating that the disease was imported in the persons of two carpenters from Dawoolya, a railway station in Siberia situated some 6 miles west of the boundary line; a circumstantial account to this effect is on record. Further, it has been suggested that the infection might be traced westward in a chain of pneumonic cases to more distant towns in Siberia. These suppositions are certainly plausible, but however true they may be, they convey only part of the truth for the reason that they fall short of the ultimate source of infection. The important consideration is, that, with our present knowledge of the etiology of plague, every case of human plague, whether bubonic or pneumonic, seems traceable finally to animal plague. From this point of view it is noteworthy that no evidence is forthcoming opposed to the conclusion that the primary source of the infection in Manchouli is to be sought for in the vast region including trans-Baikalia, northern Mongolia, and northwest Manchuria in which tarbagans abound.

THE TARBAGAN QUESTION IN RELATION TO THE ORIGIN OF THE EPIDEMIC

Within recent years the trade in tarbagan furs has increased greatly, large numbers of the furs being annually exported to Europe. It has been stated that every year 2,000,000 skins are sent over the Trans-Siberian Railway to Moscow and thence to Leipzig and London, where they are converted into imitation marten and sable furs. During the last few years the price of the skins has gone up from 20 kopecks to 1 rouble 20 kopecks [from about $0.12 to $0.72 United States currency]—a six-fold increase. In consequence of the increased demand for the skins and of their enhanced value, the original Mongol and Buriat trapping community has been reinforced by Chinese trappers. Many of the latter class are migratory residents whose homes are in the northern provinces of Shantung and Chihli. The season for hunting the tarbagan is from August to the middle of October. During this time the hunters camp out on the plains, and at the end of the season when the animals begin to hibernate—the hibernating season lasts from October to April—they

return with their spoils to the towns. The principal local center of the fur trade is Manchouli, where several Russian firms buy and export the skins. It is estimated that in the third week of October, 1910, when the epidemic broke out, fully 10,000 tarbagan hunters gathered in Manchouli and Hailar with their skins, waiting to sell them and then return south for the winter. Here "they crowd into very poor hovels or inns, where with piles of raw pelts they may often be found living, sleeping, and eating, from twenty to forty in the smallest of badly ventilated rooms, the conditions being thus ideal for the encouragement of any epidemic disease."

It has been known for many years that in eastern Siberia and Mongolia the tarbagan, or marmot, suffers frequently from a fatal epizoötic which may be transmitted to man, producing in him symptoms indistinguishable from those of bubonic and pneumonic plague. It is unnecessary in this place to recount instances of the association of the tarbagan disease with human plague outbreaks. Let it suffice to state that Russian medical investigators, from inquiries made on the spot, appear to have clearly established the relationship. While on epidemiological grounds it would seem undoubted that the disease in the tarbagan is plague, this belief awaits confirmation from bacteriological observations on naturally infected tarbagans. It is well known that the tarbagan disease has a definite seasonal prevalence, namely, in the autumn months preceding the hibernating season which lasts from October to April. It will be noted that the prevalence of the disease coincides with the hunting season.

The Mongol and Buriat trappers, taught by long experience and traditional knowledge, are skillful in recognizing symptoms and signs of disease in the tarbagan and avoid such animals, since they fully appreciate the risks of handling them. The recently imported Chinese trappers, on the other hand, are naturally less skillful in this respect, and are tempted by the high price given for the skins to take the risk of skinning animals found sick or dead. Curiously enough, it is stated that the hunters are free from the disease during their sojourn in the open country, and that it is only when they congregate in the overcrowded caravansaries of Manchouli and Hailar that they are subject to attack from plague.

In this connection, the information laid before the Conference and summarized in the following table as to the distribution of plague since 1905 in the region referred to must be regarded as extremely important, since it shows that in 1905 and 1906 the infection was present in Manchouli and the surrounding

districts. Dr. Iasienski, who contributed this information, remarks: "With regard to the question whence and how the plague was brought to these places, it may be asserted with considerable confidence that the disease in 1905 as well as in the following years was brought about by sick tarbagans."

Table summarizing Dr. Iasienski's information regarding plague infection in the region in which the Manchurian epidemic originated

Date.	Place.	Type of disease.	Number of cases or deaths.
1905 (August)	Chalainor colleries' settlement	Bubonic	13 deaths.
Do	Manchouli	do	2 deaths.
1906	Abagaitui [a]	Pneumonic	6 cases.
Do	Manchouli	do	2 cases.
1907	Trans-Baikal District [b]		Several cases.
1908	Trans-Baikal District and Mongolia. [b]		
1909 [c]			
1910	Manchouli	Pneumonic	

[a] 20 miles (30 versts) from Manchouli station. [b] Railway territory free. [c] Everywhere free.

It will probably be conceded that the above-mentioned considerations provide material for constructing a strong case incriminating the tarbagan as the originator of the outbreak in the town of Manchouli, the more so as not a particle of evidence exists to show that in this part of the world rats or rodents other than the tarbagan are liable to epizoötics of plague.

If, as seems justifiable, we accept the view that the tarbagan in nature is liable to plague infection and that from such infection the Manchouli epidemic of pneumonic plague ultimately arose, we ought next to inquire into the mode of spread of the disease among these animals and the method of its transmission to man. Such inquiries lead at once into the region of speculation where it would be unprofitable to pursue them. It is certain, however, that extended research on the spot will throw light on many interesting questions to which at present no answer can be given. In particular, the problem of the persistence of the infection among the tarbagans throughout the hibernating season is of considerable biological interest and would seem to be one which has no parallel in the phenomena of rat plague. Then again it is clear that any explanation of the normal mode of spread of the epizoötic is worthless which does not at the same time definitely elucidate the seasonal prevalence of the disease. Investigation on these lines is the first step toward solving the problem of the transmission of the infection from the tarbagan to man.

THE FACTORS WHICH CONTRIBUTED TO THE GENERAL DISSEMINATION OF THE EPIDEMIC

It may be said with truth that to possess a knowledge of the railway systems of northern China is to understand the principal lines of diffusion of the epidemic. Unquestionably the railways played a predominant part in the spread of the disease, so that it becomes a matter of some moment to give a brief preliminary account of the railway systems involved and of the general features of the country through which they pass.

A NOTE ON MANCHURIA AND ITS RAILWAYS

Manchuria, officially styled by the Chinese "The Three Eastern Provinces" on account of its position to the east of China proper and of its division into three provinces—named from north to south Heilungkiang, the largest and least populous; Kirin, the central province; and Fengtien, the smallest but most populous—has an area equal to that of France and Germany combined, with a population of some 20,000,000.

Tsitsihar, situated 200 miles northwest of Harbin and 10 miles north of the Chinese Eastern Railway, is the capital of Heilungkiang, the northern province. Kirin, a large and important city not yet connected with the railway, is the capital of the central province, and Mukden, an important railway center and the seat of the viceroyalty of Manchuria, is the capital city of Fengtien, the southern province.

The communications for trade and travel are on the whole good, and consist of railways, roads, and a number of excellent waterways navigable in the open season for junks and small boats, but icebound in the winter. The chief waterways are the Amur, with its tributaries the Sungari and Nonni in northern Manchuria, and the Liao in southern Manchuria.

The following remarks on the climatic conditions in Manchuria by Hosie may be quoted, since they have an important bearing on the question of the spread of the epidemic:

> The climate of Manchuria may be described as extreme. In the Heilungkiang Province the temperature falls as low as 49° F. below zero in winter and rises as high as 90° F. in summer. On the morning of the 19th of January, 1896, while I was in Kirin, the temperature fell to −34° F. in that city, and the average minimum from the 15th to the 28th of January was −20° F. The maximum temperature in summer is about 95°F. In Mukden the lowest reading in winter is about −28° F. and the highest in summer about 96°. From the beginning of December to the end of March all waterborne traffic ceases to the north of Newchwang, the whole country being icebound during these four months. The ports in the south of the Liaotung Peninsula are, however, open all the year round. In

the north of Manchuria snow falls to a depth of two or three feet, while in Newchwang it rarely exceeds 12 inches. The summer heat of Manchuria is dry and easily endured, but the winter cold is intense, especially when a northeast wind blows. The rainfall is small, usually averaging about 13 inches, half of which falls as a rule in the months of July and August. When the country is icebound, the roads in the interior, bad at their best, are suitable for cart traffic; when it begins to thaw and during the rainy season the soft loam, of which they are composed, becomes a veritable quagmire, wherein animals are frequently suffocated or drowned. Climate, therefore, has a very important influence on the traffic of Manchuria, and it will continue to exercise that influence until railways connect the three provinces and bring the remote districts of Heilungkiang within as many hours of the Yellow Sea or Liaotung Gulf as they now are days.

Since the area affected by the epidemic includes the two northern provinces of Chihli and Shangtung, a few brief notes on these may with advantage be added. A glance at the map will show their geographical position relative to each other and to Manchuria. Chihli, the metropolitan province of China, supports a population equal to that of Manchuria, viz, 20,000,000, although only one-third of the size. The provincial capital is Paotingfu, on the Peking-Hankow Railway, but the most important cities in the province are Peking, the Imperial capital of China, and Tientsin, a busy industrial city. The climate of Chihli is one of extremes, the summer being exceedingly hot, the thermometer frequently reaching 110° F. in Peking, whereas the winter is intensely cold. Frozen rivers and ice-locked ports are not the least of the inconveniences of the winter season.

Shantung is a densely populated province, the density per square mile having been estimated at about 500. The people are sturdily built and of frugal disposition. The colonists of Manchuria, either permanent or temporary, are largely recruited from the inhabitants of this province and of Chihli. Tsinanfu, with a population of about 100,000, is the capital. The treaty port of Chefoo is an important town in relation to the epidemic, because it is the port of entry and departure of travelers into and from the province and of steamers and junks plying between this port and those on the Liaotung Peninsula and the Gulf of Pechihli. The distance between Chefoo and Dairen (Dalny), the terminus of the South Manchuria Railway, is 87 miles.

THE RAILWAY SYSTEMS OF NORTHERN CHINA

Reference to the map [see Plate XV] will render even a brief description of the railways almost unnecessary, but for the sake of clearness the following notes are recorded. The Chinese Eastern Railway is administered by Russia and is a continuation of the Trans-Siberian Railway. The railway runs across Manchuria from the town of Manchouli, near the Siberian border, to

Vladivostock, the final stage of the line passing for about 100 miles through the Russian maritime province of Primorsk. A branch section joins the main line at Harbin, the center of the Russian railway administration, and taking a southerly direction for nearly 150 miles terminates at Kwanchengtze (Changchun), a large commercial city and a collecting and distributing center for the agricultural wealth of Heilungkiang and Kirin.

The South Manchuria Railway, under Japanese control, extends south from Changchun to Mukden (189 miles) in continuation of the Chinese Eastern Railway. Here the line bifurcates, one branch running through the Liaotung Peninsula to Dairen (249 miles from Mukden) and Port Arthur and the other joining the Korean Railway at Antung. From Mukden also a line operated by the Imperial Railways of North China (Chinese control) brings Tientsin and Peking into direct communication with the Trans-Siberian Railway and thus with Europe. This railway passes through a gap in the Great Wall of China at Shanhaikuan, 230 miles from Mukden. Three railway systems south of Peking, two of them connecting Shantung and Chihli with the Yangtsze Valley, must be mentioned. The Peking-Hankow Railway (under Chinese management) traverses Chihli on its way to the Yangtsze River. The Tientsin-Pukow [1] Railway is not yet completely constructed, but the upper and lower portions, the former intersecting Chihli and Shantung, are open for traffic. The third railway, the Tsinanfu-Tsingtao line, under German control, effects a junction with the Tientsin-Pukow line at Tsinanfu, the capital of Shantung, and runs across the province to its terminus at Tsingtao, the port of the German leased territory of Kiaochow.

THE INFLUENCE OF COOLIE MIGRATION ON THE SPREAD OF THE EPIDEMIC AS EXEMPLIFIED BY THE MUKDEN OUTBREAK

The description of the principal events which marked the course of the epidemic from its starting point at Manchouli will be facilitated if, first of all, an explanation is given of a most important factor in the dissemination of the disease, namely, the migration of the Shantung and Chihli coolies. It has been remarked already that Manchuria is sparsely populated. The development of its vast resources has been hampered by the circumstance that the permanent dwellers on the soil are of themselves unable to cope with the land they have taken up. In consequence of the expansion of agricultural and trade interests in the country in recent years, a large annual importation of labor takes place from the northern provinces of China, in

[1] Pukow is a town on the Yangtsze River directly opposite Nanking.

particular Shantung and Chihli. An example of this influx of labor has previously been given in the account of the tarbagan hunting industry of northwest Manchuria. The Shantung coolies sail in the early spring by steamers and junks from Chefoo to ports in the south of the Liaotung Peninsula—e. g., Newchwang and Dairen—and distribute themselves over the whole country by taking advantage of the railways. The Chihli laborers naturally avail themselves of the railway routes to the north.

In addition to the general laborers, some thousand petty merchants migrate north from these provinces. An increasing number of the Chihli and Shantung emigrants settle permanently in Manchuria. It is difficult to compute with accuracy the number of migratory coolies, but probably 100,000 is not an overestimate. When outdoor work is suspended on account of the severity of the winter, they return home by the same routes. They make it a duty to return in time for the Chinese New Year festival, a variable date, falling in 1911 on the 30th of January.

In order to illustrate the spread of the infection by returning coolies, the following notes on the epidemic in Mukden are recorded:[1]

The first known case of plague in Mukden occurred on the 2d of January, 1911. The patient came from Harbin by rail, was found lying ill on the street, and died next day in the Government Hospital. Within the next ten days 15 cases occurred. Most of them came by rail from the north, and died either by the wayside or in small inns and tea shops in the west district, between the railway station and the city. The remainder were contacts from these cases, inn employees, or dwellers in neighboring hovels.

Coolies traveling by rail from the north continued to arrive in Mukden, unhindered by quarantine or any restriction whatsoever, with the result that the plague cases in the city steadily increased, especially in the west district.

The preventive measures taken in Mukden would probably have speedily suppressed the outbreak had not fresh infection continued to pour in from the north. About 1,000 coolies were brought daily by rail from the infected districts, many going south by the Chinese railway and many others remaining in Mukden and the vicinity. At an early stage, strong representations were made to the authorities concerned that railway traffic from Changchun should be stopped, but this was not done until a large part of Mukden was infected, nor indeed until after the Imperial Chinese Railway from Mukden to Shanhaikuan was closed. At last it was decided to close the Imperial Chinese Railway for coolie traffic, and on the 14th of January the last train load of coolies left Mukden for Shanhaikuan. Two deaths from plague occurred in the train on the journey south, and next day all the coolies to the number of 478 were sent back to Mukden.

Dr. Jackson, who was in charge of plague operations in the railway area,

[1] These notes of the Mukden outbreak were kindly sent to me by Dr. Dugald Christie. They have been abstracted from Dr. Christie's account without material alterations.

housed the coolies in inns near the station, with guards to prevent their escape. These inns, although the best accommodation available, were quite unsuited to the purpose, being low roofed, dark, and dirty. Several of the coolies died daily, and in course of time most of the inns became infected on account of the lack of facilities for proper isolation. On the night of the 23d of January, eight days after their return to Mukden, over a hundred coolies broke out from their quarters and escaped. They could not be traced, but it was evident that they spread the infection, because a week later there was a sudden rise in the number of deaths reported in the city. Of the remaining coolies 59 were discharged, and the rest were removed on the 24th to proper isolation stations. On the same day Dr. Jackson was taken ill with pneumonic plague and on the following day he died.

A GENERAL ACCOUNT OF THE SPREAD OF THE EPIDEMIC

When analyzed, the Manchurian epidemic of pneumonic plague resolves itself into a succession of minor epidemics of greater or less magnitude, conditioned by the size of the city, town, or village into which the infection was introduced, and by local circumstances either favoring or limiting its spread. It will be remembered that the first serious outbreak manifested itself on the 13th of October, 1910, in the town of Manchouli, the western terminus of the Chinese Eastern Railway in northwest Manchuria, near the Siberian border. During the nine weeks the epidemic lasted, there were 392 deaths from pneumonic plague, nearly all of them among the Chinese population.

Within a fortnight of the outbreak in Manchouli the infection, carried by traveling Chinese trappers, spread eastward along the Chinese Eastern Railway; several stations on the line between Manchouli and Harbin became infected, and plague-stricken passengers were found in the trains.

On the 27th of October, 1910, the first plague case—a man who had arrived from Manchouli—was discovered in Russian Harbin, and on the 7th of November the infection entered the adjoining Chinese town, Fuchiatien, starting here the most severe localized outbreak recorded in the whole history of the epidemic. The origin of the epidemic in Fuchiatien is ascribed to two tarbagan hunters from Manchouli who lodged in the shop of an artesian-well mechanic, died of plague here, and infected four men with whom they were living. It is difficult to estimate the number of inhabitants in Fuchiatien, but the fixed or resident population may be said to amount to about 20,000, with an additional floating population (migratory coolies) of between 5,000 and 10,000. Within the next three months there were 5,000 deaths in the town. As might be expected, Fuchiatien and the Chinese quarter of Harbin, which itself contains 20,000 people and which was also badly infected, constituted a focus from which the disease spread in every direction.

The time and place relations of the epidemic as a whole will be easily grasped if we consider the course of the epidemic as being marked off into three stages, the more so as this division appears to be a natural rather than an arbitrary one.

The first period, already summarily described, extends from the 13th of October to the 27th of October, the dates of the first cases in Manchouli and Harbin; the distance between these towns is 530 miles. The second stage comprises an interval of sixty-five days between the origin of the infection in Harbin (27th of October) and the date (31st of December) when the outbreak occurred in Changchun, the junction of the Chinese Eastern and South Manchuria Railways, 150 miles to the south of Harbin. The third stage corresponds to the widespread dispersion of the infection during the month of January throughout the whole of the rest of Manchuria and even into the provinces of Chihli and Shantung. The outbreak in Changchun is attributed to a merchant who, after visiting Harbin, returned to his shop and infected his relatives; the epidemic which ensued was responsible for at least 2,000 deaths, so that this city became a second focus from which the infection spread by rail and road over the country. Mukden was attacked on the 2d of January, and, although energetic preventive measures were carried out, the outbreak here was so severe as to make of this city a third principal focus of infection.

The rapidity of the subsequent spread of the infection in the third stage is sufficiently indicated in the statement that the plague appeared in Tientsin on the 13th of January, Peking on the 12th of January, Dairen on the 4th of January, Port Arthur on the 20th of January, Chikuanshan (on the Mukden-Antung line) on the 16th of January, Chefoo on the 21st of January, Tsinanfu (in Shantung) on the 1st of February, and Paotingfu (in Chihli) on the 16th of January.[1]

The rapid and widespread dissemination of the infection during the third period in January appears to be attributable to two main causes, first, the accumulation of infection in the populous cities, Harbin (Fuchiatien), Changchun, and Mukden, and, secondly, the streaming south of the Shantung and Chihli coolies in their endeavor to reach home in order to participate in the Chinese New Year festival on the 30th of January. When once the infection obtained a foothold in Chihli and Shantung, it spread from Chefoo and from the railways along the roads to the villages throughout the provinces.

[1] The dates assigned for the origin of infection in some of the towns in Manchuria must be regarded as only approximate.

THE DISSEMINATION OF THE DISEASE BY ROADS, RIVERS, AND SHIPPING

That the primary track of the epidemic followed the railway routes is unquestionable, plague cases frequently being discovered in south-bound coolie trains, but none the less it is equally certain that a secondary extension took place along the roads joining the chief towns in Manchuria. On the highways during the winter "the whole energy of the country centers in the conduct of the immense traffic to the trade depots. In spring and summer and autumn, on the other hand, when the icy grasp of winter is relaxed and the rivers are open to navigation, the roads, owing to their softness, are all but deserted." The favorable conditions of the roads for traveling, while the epidemic was at its height, led many of the coolies to choose these routes on their journey south, especially when quarantine regulations were adopted and enforced by the different railway authorities and when, as happened late in the epidemic, they were prohibited from traveling by rail.

Tsitsihar, Petuna, Kirin (75 miles southwest of Changchun), Fakumen, and Yungpingfu may be mentioned as important towns which became infected although situated at a considerable distance from the railways.

In Manchuria there is only one main road that is of more than local importance, namely, the one from Peking to Siberia by way of Yungpingfu, Shanhaikuan, Mukden, Kirin, Petuna, Tsitsihar, and Mergen; the last town is situated to the north of Tsitsihar.

Petuna lies in a vast, marshy tract of country. The road over this marsh is impassable in summer, but in winter it is frozen and becomes a highway for south-bound coolies tramping homeward. There is also a considerable trade intercourse between Tsitsihar and Petuna. The former town became infected on the 4th of December directly from the outbreak in Manchouli. It is not surprising, then, that the plague was introduced into Petuna from Tsitsihar, and, as a matter of fact, deaths were notified in various hamlets along the main road between the two towns.

There is no reason to suppose that the navigable rivers played any appreciable part in spreading the disease. In winter they are frozen, and, although especially in central and northern Manchuria they are utilized as traffic routes, they can not be reckoned with as even a subsidiary factor in the extension of the epidemic.

The Shantung coolies on their journey homeward traveled by rail and road through the Liaotung Peninsula until they reached

Dairen and Port Arthur, where, carrying the infection with them, they embarked on steamers, boats, and junks for Chefoo and the mainland of Shantung.

CIRCUMSTANCES WHICH FAVORED THE SPREAD OF THE DISEASE WITHIN TOWNS AS ILLUSTRATED IN THE EPIDEMIC OF FUCHIATIEN

With the growth of Harbin, Fuchiatien, the Chinese suburban town, has sprung up within the past fourteen years until it now contains a population of between 20,000 and 30,000. About one-fifth of the population consists of coolies from the south. These men find accommodation in numerous inns and eating houses scattered throughout the town. There they live under conditions of great congestion. The typical house or inn in the town is a one-storied, mud-built, badly lighted structure with mud floors and windows sealed tightly with paper during the winter to exclude the bitterly cold air. Provision for ventilation is discouraged for the same reason. Insanitary conditions external to the houses are common, but these need not be particularized, since they do not appear to have had any direct bearing upon the spread of the epidemic. Owing to the extreme cold of winter, the urgent necessity is to heat the houses sufficiently for comfort, and the arrangement for securing this is an ingenious one. In the case of an inn consisting of a long one-storied building, there will be found extending along the whole length of the building on each side and occupying most of the original floor space a raised brick platform some 2 feet high and 6 or 7 feet broad. This *k'ang*, as it is called, is covered with a straw mat made from the outer sheaths of the stalk of the tall millet, kaoliang, and serves the purpose of bed, chair, lounge, and eating place. Through it runs a system of brick-lined flues heated chiefly by a brick furnace, or oven, used also for cooking purposes at one end. Openings at intervals on the floor-level along the *k'ang* are used for additional fires, and these are often fed by the dried kaoliang stalks placed on the floor and pushed farther in as they are consumed. During the night the inmates lie packed together on the *k'ang* in order to economize space and for the sake of additional warmth. The severe cold prevailing during the epidemic had the effect of keeping the people indoors.

It would be difficult to imagine conditions more favorable to the propagation of pneumonic plague within houses. Unfortunately the organization of preventive measures was not completed for some time after the disease had gained a firm footing in the town, and in consequence the death roll steadily mounted

until the climax was reached on the 28th of January with a death return of 173 cases. The epidemic then gradually subsided, and finally disappeared about the beginning of March. During the four months the epidemic lasted, 5,138 of the inhabitants died of plague.

INSTANCES OF TOWNS WHICH ESCAPED THE INFECTION OR WHICH WERE ONLY SLIGHTLY AFFECTED

There are several instances of places which appear at first sight to have been fortunate in escaping the infection altogether or in suffering from only a limited outbreak. Tongshan is a town of about 5,000 inhabitants on the main line between Mukden and Peking, which entirely escaped, although other towns on the line became infected. The reason probably is that practically the whole population of this town is employed in the service of extensive mining and engineering works and does not contribute to the migratory horde of coolies. Again, the port of Chinwangtao on the Gulf of Pechihli remained free of plague, although it has communication with Chefoo and thus with Shantung. The Shantung labor coolies preferred to use the Dairen-Chefoo route as being more direct with a shorter sea journey; strict quarantine regulations, no doubt, also accounted for the immunity of Chinwangtao. The port of Newchwang near the mouth of the Liao River escaped, since on account of its being ice-locked during the winter months the intercoastal traffic is suspended.

The comparative freedom of Tientsin (111 deaths) and of Peking (17 deaths) is explained by the fact that the migratory coolies do not reside there, and, therefore, passed quickly through on the way to their homes farther south; moreover, the authorities in these cities were warned of the danger, and were able by stringent preventive measures to check the spread of the disease

THE RELATION OF ANIMAL PLAGUE TO THE EPIDEMIC

The rôle of the tarbagan in the origin of the epidemic has already been discussed.

With regard to rat infection, it is quite clear that an epizoötic of rat plague during the progress of the epidemic did not exist. Examination of rats was made in various towns in Manchuria by several investigators and no evidence was forthcoming that plague infection in the rats had any share in the dissemination of the disease. On the other hand, the question—a very pertinent one—was raised and discussed as to whether the rats, which are numerous in Chinese houses, might not have run the risk of becoming infected incidentally from human plague cases

in the course of the epidemic. The two most probable suggestions on this score were (1) that rats might become infected by feeding on the sputum of plague patients or on food contaminated with such sputum, and (2) that they might become infected by gnawing exposed plague corpses. The importance of rat infection brought about in this way lies in the possible sequel of an outbreak of human bubonic plague. The future is the best criterion of the likelihood of such a contingency, but it may be remarked that a sporadic case of intestinal infection occurring in rats during a winter epidemic of pneumonic plague would not be likely to set an epizoötic alight on account of the relative fewness of rat fleas infesting the rats. Evidence was in fact produced showing that in Manchuria the curve of rat-flea infestation is lowest in winter and highest in autumn. [See Plate XVIII, p. 60.]

It is a curious circumstance that in many epidemics of plague an unusual mortality among domestic and other animals has been reported. The present epidemic is no exception to the rule. Unfortunately, however, the data bearing on the broad question of the relation of animal plague to the epidemic are so scanty as to be inconclusive. In a question of this kind, epidemiological evidence founded on one or two instances only and unsupported by bacteriological investigation may be highly suggestive, but it is none the less liable to misinterpretation. The reported cases, accompanied by bacteriological proof, of the spontaneous occurrence of pneumonic plague in a dog and in two donkeys,[1] although extremely interesting, are too few to admit of deductions being drawn as to the degree of danger of infection to which these animals are exposed under natural conditions and as to the mode of infection in nature.

Further investigations alone can decide whether the infectivity of human and animal plague is reciprocal and whether, indeed, pneumonic plague in animals occurs with sufficient frequency to entitle it to epidemiological importance.

DISCUSSION OF CERTAIN POSSIBLE MODES OF TRANSMISSION OF THE INFECTION

The exclusion of rat infection as a contributory factor in the dissemination of the epidemic simplifies considerably the discussion of this question. It can scarcely be doubted that the epidemic was a purely pneumonic one. This statement is made without prejudice to the possibility (one of several) that just before the epidemic broke out in northwest Manchuria, a bubonic

[1] See also Part III, pages 439, 440.—[EDITOR.]

(septicæmic) case, complicated with a secondary plague pneumonia, may have occurred, and that the epidemic may be traceable to such a case.

Bubonic cases, if occasional instances of cervical buboes be excepted, do not seem to have been noted; these buboes are readily explained on the assumption of infection of the upper respiratory passages. Axillary buboes due to infection with plague sputum through skin abrasions of the hands of contacts, although apparently not observed, might have been expected to occur. From an epidemiological standpoint, however, these types of infection are merely incidental to the main type, that of primary pneumonic plague.

DIRECT INFECTION FROM MAN TO MAN

That persons in the incubation stage of the disease and sick persons are capable of introducing the infection into uninfected communities would seem, from our knowledge of the pathogenesis of the disease, to admit of no doubt. Only one case of a healthy carrier of the disease, in which bacteriological observations were made, was described. The history of this case, in spite of gaps in the evidence on the bacteriological side, is circumstantial and suggestive, but, assuming it to be an authentic example of a healthy carrier, it gives no clue to the main point of interest, namely, the frequency with which similar cases occurred. These remarks apply with equal force to the instances recorded of natural immunity to plague pneumonia.

The question of the degree of contact required for infection, or, stated otherwise, the range of infectivity of the plague patient, is one which can not be said to be illuminated by the available epidemiological evidence. On the whole, the impression produced by perusal of the evidence is that intimate personal contact is usually necessary for infection to take place.

INDIRECT INFECTION FROM HUMAN SOURCES

Gross deposited infection (sputum) on clothing, merchandise, "k'angs," floors, etc.—It is certainly striking that no evidence which will bear strict scrutiny has been advanced incriminating articles of clothing as agents in the transmission of the infection or proving that houses are infective apart from the plague patients within them. In order to carry conviction, an account complete in every detail must be given of instances purporting to illustrate these conceivable modes of infection. The difficulties of fulfilling this requirement in a widespread epidemic of pneumonic plague are extreme, and consequently opportunities for committing the *post hoc propter hoc* fallacy are abundant.

Ultravisible infection of inanimate objects.—A minor degree of infection of inanimate objects may take place by secretions charged with plague bacilli and expelled in the act of coughing. Comment under this head is scarcely needed, except to remark that our present knowledge does not justify us in claiming these methods of infection as even occasional.

DISCUSSION OF THE CAUSES OF THE DECLINE OF THE EPIDEMIC

The difficulties in the way of a complete solution of this problem are very great. Two views were brought forward and discussed. In the first place it was maintained that preventive measures, carried out either in accordance with scientific principles or in self-defense by the people themselves alone, sufficed to explain the extinction of the plague in the towns and villages. Again the view was put forward that the influence of meteorological factors must at least be considered and, if possible, investigated. While the balance of opinion in the discussion on this point leaned toward the former explanation, it was made clear that both views may be held without involving a contradiction. There can be no doubt whatever that the enforcement of preventive measures played, and must always play, a most important part in checking and in bringing to an end an epidemic of pneumonic plague. The difficulty is to prove, or to exclude definitely, the influence of climatic conditions. It would seem almost impossible to obtain adequate data on the subject. Were it practicable to procure accurate information regarding the development of the epidemic in a number of cities and towns in which the disease pursued a natural course uninfluenced by any preventive work, and if further meteorological data were available for these places, epidemic curves might be constructed on which the aforesaid data could be charted for comparison. There are no such normal epidemic charts in the records of the Manchurian outbreak. In Fuchiatien the epidemic curve [1] shows a steep rise with an equally rapid decline, but we know that while the rise may represent normal conditions of spread, the main part of the decline was due to the vigorous preventive measures adopted. A curve of the Mukden [2] outbreak would probably exhibit an even greater distortion from the normal, because here preventive measures were enforced at an early stage.

It must be concluded, therefore, that the hypothesis of a spontaneous decline in the epidemic, while according with the invariable rule in epidemic phenomena, must remain for the present unverified.

[1] See Plate X.—[EDITOR.] [2] See Plate XI.—[EDITOR.]

SUMMARY OF CONCLUSIONS

The origin of the epidemic.—The epidemic began in a region which has been associated for years with outbreaks of pneumonic and bubonic plague, but evidence is not forthcoming as to its precise origin.

In accordance with modern views of the etiology of human plague, it is necessary to seek in some animal for a primary source of infection. The only animal which, so far as we know, is associated with human plague in this region is the tarbagan. The epidemiological evidence drawn from the records of the Manchurian outbreak, although only circumstantial, arouses a strong presumption that the tarbagan disease was responsible for initiating the epidemic.

The dissemination of the epidemic.—From Manchouli, the first seriously affected town, the epidemic followed a clearly defined course eastward and southward until it extended over Manchuria and the northern provinces of Chihli and Shantung. The principal foci of infection in the track of the epidemic were the densely populated cities of Harbin (including Fuchiatien), Changchun, and Mukden.

The diffusion of the epidemic was determined by routes of travel. The railways played the principal part, but roads and shipping also contributed their share in spreading the disease

The dissemination of the plague was greatly assisted by the streaming southward toward their homes of the migratory Chihli and Shantung coolies on their way to celebrate the Chinese New Year festival on the 30th of January.

Overcrowding, undoubtedly, contributed to the transmission of the disease within the houses by multiplying the chances of infection.

The disease was spread by direct infection from man to man, and, whatever may have been its primary origin, there is no proof that a concurrent epizoötic in rodents played any part in its general dissemination.

There has been no positive epidemiological evidence to show that infection was carried and communicated by clothing, merchandise, or other inanimate objects.

The decline of the epidemic.—The chief factor in the decline of the epidemic was probably the preventive measures which were enforced, either in accordance with scientific methods or by the efforts of the people to protect themselves. Climatic influences may have contributed indirectly or even directly toward bringing the epidemic to an end, but the evidence presented on these points is inconclusive.

CHAPTER II

SUMMARY OF THE CLINICAL FEATURES OF PNEUMONIC PLAGUE AS OBSERVED IN THE MANCHURIAN EPIDEMIC

By Dr. Richard P. Strong

Types of the disease met with during the epidemic.
Sex, age, and incubation period.
Symptoms.
Physical signs.
Diagnosis.
Prognosis and treatment.

TYPES OF THE DISEASE MET WITH DURING THE EPIDEMIC

The cases throughout the epidemic were almost entirely those of primary pneumonic plague, only two or three undoubted cases of primary bubonic infection having been reported. However, in a number of instances death occurred before there were any clinical manifestations that pneumonia was present, and in some of these cases only at necropsy was it discovered that early involvement of the lungs existed. This led to the belief that many of the cases were primarily septicæmic in character. One observer estimated, from a clinical standpoint, that about 10 per cent of the cases was of the septicæmic variety without pneumonia. However, from the post-mortem studies made we must conclude that the cases with no involvement of the lungs were exceptional ones. Nevertheless, in a few instances in which infection did not occur by inhalation but probably through the tonsils or the mucous membrane of the mouth or throat, it seems unquestionable that the lungs were either not involved or only very slightly so. Thus, in one instance of this nature, occurring during the epidemic, the lymphatic glands of the neck showed marked enlargement with hæmorrhages, and the surrounding tissues of the pharynx and larynx were very much affected, while the lung was only very slightly involved. Obviously, this case should be regarded as primarily of bubonic character. However, from experiments in animals, as well as from clinical

experience, we must conclude that primary septicæmic infection may sometimes occur, the organism entering through the mucous membrane of the mouth and throat and causing death from septicæmia before lesions, which are macroscopically visible, are present in the lymphatic glands or in the lungs. [See Pathology, p. 454.]

Several cases of primary intestinal plague were reported in which bloody diarrhœa appeared to be the most prominent symptom. None of these cases was studied at necropsy. It was the prevailing opinion of the Conference that no definite evidence of the occurrence of primary intestinal infection had been produced. In the few instances in which plague bacilli had been found in the fæces, infection had evidently occurred secondarily from the blood.

SEX, AGE, AND INCUBATION PERIOD

Both sexes are equally susceptible, but the proportion of females and children attacked was comparatively small, as women and children were evidently not so frequently exposed to infection. The disease prevailed particularly among the poorer classes, coolies, etc., the majority of whom were between 20 and 40 years of age. The incubation period may vary from two to five days, though usually it is not over two or three days.

SYMPTOMS [1]

The onset of the disease is usually somewhat abrupt; prodromal symptoms are rare. The disease usually begins with chilly sensations, but a distinct rigor generally does not occur. Epistaxis is generally not present. There is headache, loss of appetite, an increase in the pulse rate, and fever. Vomiting rarely occurs. Within from twenty-four to thirty-six hours after the onset, the temperature usually has reached 103° or 104° F., and the pulse 110 to 130 or more beats per minute. Cough and dyspnœa usually appear within twenty-four hours after the onset of the first symptoms. The cough is usually not painful. The expectoration is at first scanty, but soon becomes more abundant. The sputum at first consists of mucus which shortly becomes blood-tinged. Later the sputum becomes much thinner and of a bright-red color; it then contains enormous numbers of plague bacilli in almost pure culture. The typical rusty sputum of croupous pneumonia has not been observed. The conjunctivæ become injected, and the tongue coated with either a white or

[1] For a more complete account of the clinical features of the disease, the reader is particularly referred to the articles on pages 163 and 171.

brownish layer. The expression is usually anxious, and the face frequently assumes a dusky hue. Labial herpes has never been observed. The patients sometimes complain of pain in the chest, but usually this is not severe. Apart from the disturbances due to the dyspnœa and their anxiety for their condition, they usually appear to suffer but little and usually do not complain of pain. In the later stages of the disease, the respirations become greatly increased and the dyspnœa usually very marked, the patients frequently gasping for air for several hours before death. Cyanosis is then common.

The signs of cardiac involvement are always marked in the advanced cases, the pulse becoming gradually more rapid, feeble, and running; finally it can not be felt.

Gallop rhythm of the heart sounds are frequently observed. Death takes place from cardiac paralysis and exhaustion. The patients frequently succumb after slight physical exertion, such as sitting up in bed to take nourishment or on being moved. A few hours before death the temperature often declines to below normal. Delirium and coma are frequently present before death.

The urine in the later stages may show the presence of albumin. The diazo and indican reactions have not been observed in the few cases in which the urine was tested. Extravasations of blood have been found in the pelves of the kidneys at post-mortem examination.

The spleen is usually not palpable, and the lymphatic glands not enlarged. Petechiæ or larger hæmorrhages of the skin are usually not present. Bloody diarrhœa is occasionally observed. Plague bacilli frequently may be present in the blood in such numbers that a simple, microscopical examination suffices for their detection; in other cases, cultures are necessary for their discovery. A marked leucocytosis may occur, though in some cases the leucocytes are not increased. In the *primary septicæmic* cases the course of the disease is very rapid. There may be no manifestations of disturbances of the lung. The cardiac symptoms are very prominent. The patients soon pass into a comatose condition and die.

PHYSICAL SIGNS

The physical signs in the lungs are often slight, even in cases well advanced in the disease. On percussion, dullness is often absent, and the vocal fremitus and resonance unchanged. In a small proportion of cases, however, smaller or larger areas of dullness may be discovered. On auscultation, râles are frequently not present, except shortly before death. When present early in the disease they are usually of the fine variety. Numerous

moist râles are heard late in the disease, and are due to the œdematous condition of the lungs. The character of the râles is in accordance with what one would expect from the condition of the lungs and bronchi and the character of the exudate observed at necropsy. Coarse râles such as occur in cases of catarrhal bronchitis usually are not present. Feeble, respiratory sounds, tubular modification, or pure tubular respiration over small areas are the conditions found most commonly on auscultation. Not infrequently a dry, pleuritic rub is heard.

The limits of dullness of the heart are sometimes increased to the right of the sternum. The heart sounds are rapid and usually become feeble or embryocardiac in character toward the end. In the early stages the secondary pulmonic sound may be accentuated, but it soon becomes much less distinct.

DIAGNOSIS

The diagnosis is usually clear from the bacteriological examination of the sputum in which the bacillus is found in enormous numbers and in almost pure culture. A rise in temperature and an increased pulse rate are usually the earliest symptoms observable, but before the sputum appears the diagnosis may be doubtful. An examination of the blood, either microscopically or by culture, may reveal the diagnosis, since during the past epidemic all the cases became septicæmic. The blood should always be examined early, by cultural methods, as in the primary septicæmic cases involvement of the lungs may not occur. The bacteriological diagnosis is the only certain one for excluding pneumonic infection due to microörganisms other than *Bacillus pestis*, but from the general condition of the patient, in connection with the absence of marked physical signs in the lungs, the diagnosis of pneumonic-plague infection is often particularly suggested. Labial herpes has not been observed in primary pneumonic plague. The presence of numerous coarse, piping or sibilant bronchial râles in the lungs is an argument against pneumonic-plague infection. The sputum in pneumonic plague is not purulent as it frequently is in catarrhal bronchitis or in bronchial pneumonia, and it is not so tenacious and has not the rusty appearance of the sputum so often seen in croupous pneumonia. The cough is usually not so painful as in croupous pneumonia.

The duration of the disease is usually less than two days, though many cases did not live longer than sixteen hours after the onset of symptoms. Cases sometimes survived for three, and, more rarely, for four days. In no case reported was the duration over one week.

PROGNOSIS AND TREATMENT

The prognosis is unfavorable. No cases in which the bacteriological diagnosis was complete have been known to have recovered during the epidemic.

No method of treatment seems in any way to have been successful. Treatment with serum seems in a few instances to have prolonged the duration of the illness.

CHAPTER III

SUMMARY OF BACTERIOLOGY AND PATHOLOGY OF PNEUMONIC PLAGUE

By Dr. Richard P. Strong

CHARACTERS OF THE PNEUMONIC STRAIN OF "BACILLUS PESTIS"

During the epidemic the idea became rather general that the organism of pneumonic plague differed, in some respects at least, from *Bacillus pestis* of bubonic plague. Apart from cultural variations, some physicians believed that, while the bacillus of bubonic plague on inoculation into guinea pigs gave rise to buboes, the bacillus of this epidemic, on injection into these animals, caused only pneumonia and septicæmia. Also, it was claimed by some, that the virulence of the organism of pneumonic plague was much greater than that of the bacillus of bubonic plague. These ideas were erroneous, as is apparent from a consideration in detail of the properties of the pneumonic strain arrived at from the study of numerous microscopical preparations and cultures obtained from the sputum and from necropsies performed during the epidemic.

MORPHOLOGY

From a morphological standpoint, the causative organism of the present epidemic of pneumonic plague apparently differs in no respect from other strains of *Bacillus pestis* isolated during many epidemics of bubonic plague. In stained microscopic preparations made from the organs at necropsy it appears in its most characteristic form as a short bacillus, more or less ovoid in form, swollen in the center, and rounded at the ends. It exhibits marked bipolar staining, the central portion either remaining uncolored or staining lightly. Such preparations and those made from sputum often show, besides these bipolar forms, great variation in the morphology of the organisms present. Involution forms, consisting of longer, thicker, deeply staining rods, or of organisms which have assumed a spherical or orbicular outline, or, occasionally even appearing very much as yeast cells, may be encountered. Many of these forms stain poorly, or sometimes only a portion of the organism is stained, and in the shorter bacilli the appearance of ring forms is thus produced. In agar cultures, and particularly in 3 per cent salt agar, these large involution forms and degenerating organisms of very different shapes are very numerous and characteristic: long and slender or thick bacilli and also boat-shaped, dumb-bell, ring-shaped, and spherical organisms may all be observed. The organism generally appears in preparations from agar cultures as a short or longer rod, and does not so frequently reveal the marked bipolar appearance when stained. In hanging-drop preparations no true motility is exhibited. No flagella are visible in properly stained preparations, and no spores have been demonstrated. It stains easily with all the anilin dyes, and particularly well with dilute carbol-fuchsin solution, and is easily and completely decolorized by Gram's stain.

CULTURAL CHARACTERISTICS

The cultural characteristics of the bacillus also are practically identical with those of many bubonic strains. The bacillus grows well upon neutral, or slightly alkaline, moist agar at a temperature of from 30° to 35° C., and is aërobic. After twenty-four to forty-eight hours on agar cultures inoculated with the pneumonic strain, usually small, delicate, transparent, dewdrop-like colonies appear, which after forty-eight to seventy-two hours have increased in size, are more raised, and have become less translucent. After this time many of these colonies do not perceptibly increase in diameter, while others later become much heavier and larger, so that the two types of colonies are frequently

observed in the same culture: the one smaller and more or less translucent, and the other much larger (four or five times the diameter of the smaller ones) and whiter and more opaque in character. The organism grows more slowly when first transplanted from the animal body to agar than in subsequent transplantations on agar. Microscopically, the colonies exhibit a lighter peripheral band and a thicker, raised, slightly granular center which, when examined by direct light, gives a considerably darker appearance than the periphery.

In gelatin, somewhat similar, though slightly more delicate, colonies to those on agar are formed. In stab cultures the gelatin is not liquefied. It was pointed out by some observers at the Conference that some of the freshly isolated pneumonic cultures caused no turbidity when grown in bouillon, the growth rapidly falling to the bottom of the media and leaving the supernatant fluid clear. However, this is not invariably the case, as other pneumonic cultures cause slight turbidity. These variations in the different cultures evidently depended more upon the amount and manner of inoculation of the organisms and the character of the media than upon any particular characteristic of the culture itself.

In Manila, Dr. Teague and the writer studied three different bubonic cultures recently isolated—one from Shanghai, one from Hongkong, and one from Mariveles, Philippine Islands—and three cultures from different pneumonic cases. These were each inoculated in tubes of bouillon and grown side by side at room temperature. No difference in growth as to the cloudiness of the bouillon, amount of sediment, etc., could be observed in the different tubes. In one of the pneumonic cultures and in one of the bubonic ones the growth and flocculi seemed somewhat heavier than in the other tubes. The growth in all of the cultures became visible, about the second day, in the form of fine flocculent masses which later greatly increased in size and became deposited partly along the sides and at the bottom of the tubes. The bouillon in all was slightly clouded. Microscopical specimens from the different cultures revealed chains of coccoid bacilli.

The mucus-like production of the pneumonic strain in bouillon cultures has been marked, and in performing agglutination tests it has sometimes been difficult to secure satisfactory suspensions in saline solution of cultures grown on agar—the organisms in a short time frequently becoming spontaneously precipitated. Cultivation of the organism at the temperature of the ice box has not obviated this difficulty. The mucus-like production also has sometimes apparently rendered the organism somewhat more

difficult to agglutinate. However, these phenomena have also been frequently observed with cultures isolated from bubonic cases. Three of the pneumonic cultures and three recently isolated bubonic strains were grown side by side on agar and in bouillon. Suspensions in salt solution were then made from the agar cultures. No difference in the production of the mucoid substance could be observed in the salt solution suspensions or in the bouillon cultures. While the quantity of the carbohydrates in the culture-media, the alkalinity, etc., seem to influence the mucus-like production of the organism, the same phenomenon having been observed with streptococci, comparative tests made with the same media revealed the fact that there was more mucus production with the pneumonic strain than in several bubonic cultures which had been isolated some time previously. However, when freshly isolated bubonic cultures were compared with these same pneumonic cultures, no difference in the mucus-like production could be observed.

AGGLUTINATION TESTS

The pneumonic strain agglutinates typically with serum prepared with bubonic cultures and in practically the same dilutions as several, recently-isolated, virulent bubonic strains. No greater difficulty was found in obtaining suspensions of the pneumonic strain than in the case of two of the bubonic strains with which it was compared. The third bubonic strain, isolated in Shanghai, formed less satisfactory suspensions in salt solution in that it soon became spontaneously precipitated.

The agglutinins are formed slowly in pneumonic plague, as they are in cases of infection with the bubonic strain. In the blood-serum of none of the pneumonic cases, confirmed bacteriologically and examined during life, were agglutinins found present, and hence the agglutination test was of no diagnostic significance. In three cases in which the bacteriological examination did not appear to be complete to some members of the Conference and which had received large doses of plague-immune serum, the blood-serum of the patients showed an agglutinative reaction of the same value as the curative serum injected. [See Part I, pp. 133 and 134.]

The agglutinins are also not usually demonstrable in human beings after a single plague vaccination, and only in animals which have received large doses by inoculation do they become present in demonstrable amounts. While the agglutination test performed with the patient's serum is of practically no value as a means of making a clinical diagnosis of the disease, never-

theless the test is obviously sometimes an important and valuable one in the diagnosis of *Bacillus pestis,* provided a standard immune serum is employed. However, the judgment of a true agglutinative reaction with the plague bacillus is sometimes rendered difficult, owing to the pseudo-agglutinative reactions which frequently occur, and very great care is frequently necessary, or errors in judgment may result. Perhaps with no other organism is the agglutination test more fallacious than in the case of *Bacillus pestis.*

TOXIN PRODUCTION

No additional evidence that the plague organism produces a soluble toxin was presented at the Conference. It was the consensus of opinion that the plague toxin is an endotoxin and that Markl's work on the production of a soluble toxin had not yet been confirmed. Filtered, twelve days' bouillon cultures of the pneumonic-plague strain proved to be no more toxic than filtered bouillon cultures of virulent bubonic strains. The evidence submitted was in favor of the fact that bouillon cultures of *Bacillus pestis,* which have been freed from the bodies of the plague bacilli and from the endotoxin dissolved in the liquid, are devoid of all toxic power.

Filtrates of fresh bouillon cultures of *Bacillus pestis* when injected into animals have almost no toxic action. On the contrary, the constituents of the bodies of the bacteria are extremely toxic. If a large quantity of the endotoxin be injected into the vein of a dog, the animal dies very quickly in consequence of the intravascular coagulation of the blood. On section, thrombi and infarcts are found in the heart, in the large vessels, and in the lungs. The plague toxin also produces dilatation of the arteries, lowering of the blood pressure, and alterations in the functional activity of the heart, as well as degenerative changes in the heart muscle. Similar changes may be observed in rabbits in which disturbances of the respiratory system are also noted. The toxin also produces fever and considerable disturbance of the general metabolism, as demonstrated by the malnutrition and cachexia and by the increased nitrogen and phosphorus elimination in the inoculated animals when they do not die within a short time after treatment. When the toxin is brought into more direct contact with the cells of the different organs, by intravenous injection, marked necrotic or degenerative changes appear in the parenchymatous cells, while there is frequently a stimulation of the cells of mesoblastic origin, especially of the leucocytes. It is for this reason that the lymphatic organs, with which the plague toxin comes particularly into contact,

become swollen and contain so large a number of lymphatic and myeloid elements and that the inflammatory exudates produced by this toxin are frequently so extraordinarily rich in morphological elements. In small amounts, the plague toxin appears to possess a strong, positive, chemotactic activity. However, when large amounts are quickly produced, as in pneumonic plague, the organism seems to be so overwhelmed with the toxæmia, that the power of increased cellular production and accumulation seems paralyzed and the local exudates may contain but comparatively few cellular elements.

PATHOGENICITY TO ANIMALS

Many cultures isolated during the epidemic from the lungs at necropsy have demonstrated the same pathogenicity for animals as virulent bubonic strains of the plague bacillus. The pneumonic cultures have shown themselves to be particularly pathogenic for mice, rats, guinea pigs, and monkeys (*Cynomolgus philippinensis* Geoff.), these animals dying from the same doses and succumbing within the same period after inoculation as has been observed after infection with bubonic strains. Some evidence was introduced at the Conference that suggested that when the pneumonic strains were injected subcutaneously into guinea pigs, usually septicæmia was produced very quickly and typical buboes were not obtained. Moreover, it was affirmed that the guinea pigs died within a shorter time after inoculation than in the cases in which bubonic strains were employed. However, in these instances it appears that the results were dependent upon the size of the dose inoculated, as much as one-half of an agar culture having been employed in the infection. The weight of evidence was in favor of the fact that cutaneous or subcutaneous inoculation of very small doses of the pneumonic strain into guinea pigs gave rise to the typical lesions observed in these animals after inoculation with virulent bubonic strains, particularly to typical buboes, to miliary abscesses in the spleen, and to secondary septicæmia with hæmorrhages in the different organs. These observations, since the Conference, have been borne out by very extensive experiments performed by Teague and the writer and it has been conclusively shown, in addition, that when guinea pigs are inoculated with the pneumonic cultures by inhalation, they develop primary infection of the glands of the neck, with secondary septicæmia and occasionally secondary pneumonia or, in some cases, primary pneumonia with secondary septicæmia. Very rarely does the spleen show miliary abscesses in such cases, the animals dying before such lesions develop. In monkeys (*Cynomolgus philippinensis* Geoff.), also, the cutaneous or sub-

cutaneous injection of the pneumonic cultures causes typical bubonic infection. Monkeys infected by the same cultures by inhalation develop primary pneumonic plague with secondary septicæmia and without involvement of the glands of the neck.

Tarbagans.—There has been considerable evidence brought forward during the past in support of the view that plague has existed in epizoötic form among a species of marmot, the tarbagan (*Arctomys bobac* Schreb.), but there has been no direct bacteriological proof of this fact, and we have known nothing definite before in regard to the susceptibility of this animal to plague infection. Cutaneous or subcutaneous infection of the tarbagan with virulent cultures of the pneumonic strain gives rise in these animals either to an acute bubonic or to subacute and chronic forms of plague infection. In some instances the tarbagan seems as equally susceptible to cutaneous or subcutaneous infection as the guinea pig, these animals dying in about the same time (two and one-half to five days after infection) and from the same doses of the organism. In these instances there are hæmorrhages about the point of inoculation, typical buboes, and swelling of the spleen. In other instances, after infection with the same organism and with the same doses, the tarbagans may suffer from subacute and chronic forms of plague infection. In three of these animals killed by chloroform from ten days to two weeks after infection, there were found at necropsy abscesses measuring several millimeters in diameter in the subcutaneous tissues or in the abdominal muscles, near the point of inoculation, and swelling of the inguinal glands, while the liver and spleen showed indurated, yellowish nodules also measuring several millimeters in diameter. Plague bacilli were present in small numbers in the abscesses and in the nodules in the spleen and liver. These animals, judging from their condition at the time they were killed, would probably have lived at least several weeks longer. The lesions present were similar to those which have been described in rats which have succumbed to chronic plague infection. The tarbagan is also susceptible to primary pneumonic plague when infection has taken place by inhalation. Death then occurs three or four days after infection from primary pneumonia and secondary septicæmia. Another species of marmot (*Spermophilus citillus* Linn.), very common about Mukden and the vicinity, was also shown to be susceptible to acute plague infection, these animals dying in from three to seven days after cutaneous or subcutaneous inoculation of small doses of the pneumonic strain and exhibiting at necropsy hæmorrhages about the point of inoculation, typical buboes, and acute, splenic tumor.

Donkeys.—Some evidence was introduced to show that donkeys

became infected with pneumonic plague during the epidemic. Dr. W. S. Yang reported to the Conference the death of ten donkeys, the first of which died with cough and expectoration of blood. In the case of one of these animals, a necropsy was performed and cultures were made from the heart, spleen, lungs, and liver. All of these cultures were said to show plague bacilli. It was also announced that Dr. Otsuki in Fushun had observed at necropsy two donkeys in which there was hepatization, in one in the right lung and in the other in the left caudal lobe. The pathological changes in the lungs were said to be similar to those seen in the cases of human infection. In regard to the question of plague infection in donkeys, the Conference resolved that the question of the occurrence of pneumonic plague in these animals should be made the subject of a special study with regard to their liability to the infection. Since the Conference, such a study has been made by Dr. Teague and the writer. We, however, have been unable to infect donkeys experimentally with pneumonic plague.[1] These experiments render it doubtful that these animals played any important part in the dissemination of the disease during the epidemic, and suggest that in the reported cases of pneumonic plague in donkeys the infecting organism was not *Bacillus pestis*, but perhaps some other organism of the hæmorrhagic septicæmia group.

Pigs.—It was stated that over 300 pigs had died during the epidemic at Harbin, but there was no evidence presented which showed that the disease from which they succumbed was bubonic or pneumonic plague infection, nor was any evidence submitted which showed that the disease was not hog cholera or swine plague.

One case of pneumonic-plague infection in a *dog,* observed by Dr. Takami, was referred to, in which there was pneumonia in the caudal lobe of the left lung. This dog was found in a house where seven people had died of plague infection. Experimental inoculation of dogs with the pneumonic strain showed that these animals were not very susceptible to subcutaneous infection, but that they sometimes succumbed from subcutaneous inoculation of large doses or from intraperitoneal inoculations.[2] *Pigeons* were not susceptible to subcutaneous or intraperitoneal inoculations of the pneumonic strains.

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[1] For a full account of these experiments, see *Phil. Journ. Sci.;* article in press.

[2] Dr. Teague and the writer have recently shown that dogs are susceptible to experimental pneumonic-plague infection. *Loc. cit.*

From the evidence submitted above, it seems that it is justifiable to conclude that the strain of bacillus, isolated during the past epidemic, has differed in no essential respects from the strains of *Bacillus pestis* previously isolated from other sources.

VIRULENCE

The organism seems to have retained a maximum virulence throughout the epidemic, at least all of the cultures isolated which have been studied by inoculation into animals possess this very high degree of virulence. Cultures isolated near the close of the epidemic showed an equally high virulence to those isolated near its beginning. However, the idea that this epidemic of pneumonic plague was due to the fact that the strain possessed an abnormally high virulence—much greater than that possessed by the organism of bubonic plague—and that this accounted for the very high mortality during the epidemic appears to be erroneous. The very acute course of the disease, the very high death rate during the epidemic as compared with that of bubonic plague, and the apparently increased virulence of this pneumonic strain may be satisfactorily explained by the fact that the portal of entry of the organism and the location of the primary points of infection in pneumonic plague and in bubonic plague are different. The plague organism finds in the pulmonary tissues a much more favorable and extensive medium for its multiplication and diffusion than it does in the lymphatic glands. In bubonic plague, the lymphatic glands may be said to act as filters against the general invasion of the organism by the plague bacillus, while in primary pneumonic plague there is no such mechanism for the defense of the host, the bacilli spreading rapidly throughout the lung and invading the circulation in every instance in a comparatively short time and apparently before the organism has had time to produce any appreciable quantity of immune substances. The bronchial lymphatic glands in primary pneumonic plague offer resistance to the invasion of the plague bacillus, and in every case of this disease these glands are very acutely inflamed and frequently almost of a black color from the resulting toxic hæmorrhages in the glandular substance. However, by the time the bronchial glands have become involved, the bacteria have already spread so extensively throughout the lung substance that a bacteræmia has usually occurred. Microscopical preparations made at necropsy from the lungs of these pneumonic cases invariably contain enormous numbers of plague bacilli. In no other disease are the organisms found in such

great abundance. In primary pneumonic plague, the bacilli are found in very much greater number in the lung than in the spleen, even though an advanced bacteræmia is present. This fact, also, suggests that the lung tissue offers a more favorable location for the growth and multiplication of the bacilli than does the spleen. The bacteria are also present in far greater numbers in the lung than they are ever found in the buboes or spleen in bubonic plague cases. It is, also, evident that in pneumonic plague the infected lung (which may be said to correspond to the primary bubo of bubonic plague) contains, by reason of the size of the infected area, a far greater number of plague bacilli than the primary bubo in bubonic plague. During epidemics of bubonic plague, there are occasionally small epidemics of pneumonic plague in which the same high mortality and acute course of the disease is observed as have occurred in this epidemic of pneumonic plague. This is another argument in favor of the fact that during epidemics of bubonic plague the causative organism may show the same high virulence. As examples may be cited the epidemic of bubonic plague in Japan—in Kobe and in Osaka in 1899 to 1900—in which thirteen cases of primary pest pneumonia all terminated fatally after a very rapid course, and the epidemic of bubonic plague in 1898 in Bombay in which, toward its close, eleven cases of pneumonic plague also all quickly succumbed one after the other.

All this evidence is in favor of the supposition that the organism giving rise to the present epidemic is of no greater virulence than in the case of many bubonic strains; furthermore, definite proof of this fact has been obtained from comparative inoculations made in animals with different pneumonic and bubonic cultures. Some of these experiments have been reported in the testimony of the Conference, and many more have been performed since that time by Dr. Teague and the writer. These experiments have shown that the pneumonic cultures have not possessed any greater virulence than that possessed by many virulent bubonic ones of the organism. Mice, rats, guinea pigs, and monkeys inoculated with virulent bubonic cultures die within the same period of time and from the same doses as do the corresponding animals inoculated with the pneumonic cultures. The same lesions are observed in animals after inoculation of the pneumonic strain as after the inoculation of the bubonic strain. Both strains when inoculated cutaneously, or subcutaneously, into guinea pigs and monkeys give rise to bubonic-plague infection. When the animals are infected by inhalation with either strain, similar lesions are, also, produced.

In guinea pigs, after inhalation, infection results through the mucous membrane of the throat and upper portion of the respiratory tract, resulting in buboes of the cervical glands and septicæmia, and in primary or secondary pneumonia; in monkeys, after infection by inhalation, primary pneumonic infection of the lung with secondary septicæmia results.

However, while during epidemics of bubonic plague reports have been made that there is often a marked difference in virulence in the different cultures isolated, during this epidemic of pneumonic plague the organism seems to have retained a very high degree of virulence throughout. The cultures isolated from a number of cases near the close of the epidemic, upon inoculation into animals, proved to be fully as virulent and to kill animals as quickly and in the same doses as did those cultures isolated near the beginning. That the organism retained such a stable virulence throughout the epidemic is, perhaps, not surprising when one considers that infection occurred directly from man to man or, frequently one might say, from lung to lung and without the passage of the organism through rodents as ordinarily occurs in bubonic-plague infection. Moreover, from the results of previous experiments relating to infection of animals with pneumonic plague by inhalation, we would expect that the organism would have retained its maximum virulence throughout this epidemic.

For these reasons and, also, from the fact that the acute course and mortality of the disease were not changed toward the close of the epidemic and, especially, from the experimental proof furnished by the inoculation of animals with cultures isolated near the beginning and near the close of the epidemic, we must conclude that the sudden decline and cessation of the epidemic was not due to any marked change in the virulence of the strain. Such a decline and cessation must have depended upon other causes. The plague bacillus, whether isolated from pneumonic or from bubonic epidemics, usually exhibits marked stability in virulence. While it is not a very resistant organism in nature and easily becomes destroyed under certain conditions, it usually does not become markedly attenuated in passage through the animal body, and even on artificial culture-media, after many months, its virulence is usually fully retained. Instances of spontaneous loss of virulence in culture-media have been reported, but this is not usually the case with fresh, virulent cultures. This quality of stability of virulence of the plague bacillus, so different, for example, from that of the cholera spirillum, is of particular interest from an epidemiological standpoint.

It has been suggested that toward the close of the epidemic involution forms of the bacillus were often observed in the sputum and blood of the cases infected and that this was an evidence of the loss of general virulence of the organism. Poorly-staining and swollen, degenerated forms of the plague bacillus are frequently found in cases of most acute and virulent infection and may be the result of the struggle between the serum of the host and the invading organism; they depend particularly upon the immunity of the host. In every infection a number of bacteria always become degenerated, show plasmolysis, or are killed in the attempt of the serum and cells of the host to overcome the infection. The presence of these degenerated forms may have no significance in regard to the virulence of the infecting organism, as may be proved by inoculation experiments performed with it.

VITALITY OF THE BACILLUS ON INANIMATE BODIES

Resistance to exposure.—The pneumonic strain was found to be destroyed after an exposure of one minute to 0.1 per cent sublimate solution and after ten minutes' exposure to 1 per cent carbolic acid or to 1 per cent lysol solution. When sputum containing the organism was smeared upon glass and exposed to direct sunlight, it was destroyed in from two to five hours, according to the thickness of the layer of sputum. When the sputum was exposed to the air, but not to sunlight, the organism was destroyed in from eighteen to twenty-one hours. When smeared upon cloth and exposed to the sunlight, the sputum was found to be sterile after five days.

The pneumonic strain was found to be destroyed in peptone solution after heating at a temperature of 60° C. for ten minutes in a water bath. On the other hand, it was shown that successive freezing and thawing of the organism not only did not destroy it, but that it apparently retained its complete virulence afterward and caused the death of guinea pigs, sometimes in three or four days, after cutaneous infection with it. Kasansky[1] has shown that *Bacillus pestis* still remained alive after being exposed to temperatures varying from 2° to —31° C. for periods of from three to five and one-half months. In many instances, plague bacilli were isolated, during the recent epidemic, from exhumed corpses which had been buried for three months, and in one instance for six months, the corpses having remained frozen during this time.

[1] *Centralbl. f. Bakt. etc.*, 1 Abt. (1899), 25, 122. *See also* Verjbitski, *Journ. Hyg.* (1908) 8, 203.

INFECTIVITY OF THE PLAGUE PATIENT

INFECTIVITY OF THE EXCRETA

In no other disease is the infecting organism found in such abundance in the sputum as it is in pneumonic plague. When the disease is well developed, *Bacillus pestis* is present in almost pure culture. In pneumonic plague as in bubonic plague, when the disease becomes septicæmic, the organisms are sometimes found in the urine and even sometimes in the fæces, but in pneumonic plague the sputum always contains large numbers of plague bacilli at the time when it becomes well tinged with blood. When once the sputum of pneumonic-plague cases becomes thoroughly dried it is no longer infectious, but when the sputum becomes frozen and pulverized, particles of it may be blown about and remain infective for long periods of time or until the sputum is again thawed.

INFECTIVITY OF THE BREATH

In regard to the manner of infection during the epidemic, studies were carried out to show, first, whether in cases of pneumonic plague pest bacilli become disseminated into the air by the expired air or vapor arising from the breath, as in ordinary or dyspnœic respiration, and, secondly, whether the organisms are disseminated by moderate attacks of coughing in pneumonic cases in which the cough did not result in the expulsion of particles of sputum visible to the naked eye. These questions were studied extensively by means of exposing plate cultures before the mouths of undoubted plague cases and of then identifying the organisms which developed on the plate cultures by the usual methods and particularly by animal inoculations. Guinea pigs, the abdomens of which had been freshly shaven and scarified, were also exposed before the mouths of pneumonic-plague cases.

The conclusions arrived at from these experiments are as follows:

Conclusions.—During normal and dyspnœic respiration of primary pneumonic-plague cases, plague bacilli are not usually expelled by means of the expired air.

During coughing of such cases, even when sputum visible to the naked eye is not expelled, plague bacilli in large numbers may become widely disseminated into the air surrounding the patient.

The distance from the patient, that the air may became infected by droplets containing plague bacilli, varies largely with the strength of the cough, the amount of mucus in the throat and larynx at the time, and the currents of air in circulation in the ward.

The idea that infection of doctors, nurses, attendants, etc., in plague

hospitals, is caused entirely by particles of sputum expectorated by the patient and visible to the naked eye is erroneous. It follows from these experiments that the wearing of masks and the proper covering of any surface of the skin where fresh abrasions are present are important, personal, prophylactic measures in pneumonic plague. It also follows that the eyes should be protected against this manner of conjunctival infection by proper glasses.

Articles of clothing worn in the wards should immediately be sterilized after removal, since, even though no particles of sputum may be visible upon them, plague bacilli may be present.

In the case of infection by inhalation the risk to the person exposed bears a direct relation to his proximity to the patient and the duration of exposure.

From these experiments it is very evident how dangerous an infective agent a pneumonic-plague patient is. In no other disease is the individual so dangerous and in no other disease does the danger from droplet infection approach that which exists in pneumonic plague. The number of plague bacilli expelled in droplets, from pneumonic-plague cases, is far greater than the number of bacilli ever expelled by patients afflicted by tuberculosis, croupous pneumonia, diphtheria, or influenza.

INFECTIVITY OF CORPSES

It was repeatedly shown that *Bacillus pestis* still remained living and virulent in corpses of patients who had succumbed to pneumonic plague and that had remained frozen upon the ground for three months, or in those which had been exhumed after burial for the same length of time. Human bones have been found in the burrows of tarbagans. Infection of rats and tarbagans from gnawing infected corpses both buried and unburied must, therefore, be considered as a possible source of plague. In putrid animals, the plague bacillus usually does not live longer than one week, but in one instance this organism was found to be present one month after death. In view of the length of time during which plague corpses may remain infective, complete cremation should be carried out. Also, in time of plague, the carrying and shipment of corpses should be prohibited.

INFECTIVITY OF FLEAS

No evidence was presented during the Conference showing the infectivity of fleas during the epidemic. Plate XVIII, Part I, page 60, showing the seasonal prevalence of rat fleas, indicates that fleas were not prevalent upon rats during the season in which the epidemic prevailed. Moreover, there was no evidence that rats became infected during the epidemic. No fleas were observed upon the pneumonic-plague patients.

BACTERIOLOGICAL DIAGNOSIS OF PNEUMONIC PLAGUE

EXAMINATION OF THE SPUTUM

A bacteriological diagnosis from the sputum can not be made at the onset of the disease, and not until after the fever has developed does the sputum appear. Shortly after the appearance of the sputum the plague-organism, even if not visible from the microscopical examination, may be isolated by culture. When the sputum becomes bloody, the organism is usually present in large numbers and in almost pure culture. Sometimes the organism might be mistaken morphologically for *Diplococcus pneumoniæ*, and bipolar-staining organisms, other than plague bacilli, may sometimes be encountered in the sputum. While in the microscopical examination of the sputum Gram's stain is a very valuable aid in arriving at a diagnosis of the organism, nevertheless, Gram-negative bacilli have been encountered in the sputum, which proved later not to be plague bacilli. However, usually if the sputum is blood-stained, from the microscopical examination, with the aid of Gram's stain, there is no difficulty in arriving at a diagnosis, since the plague organism is usually present in such very large numbers. In the later stages of the disease, involution forms are commonly encountered in the sputum. The organisms are constantly found in great abundance up to the time of death.

BACTERIOLOGICAL EXAMINATION OF THE BLOOD

In the early stages of the disease, cultures from the blood are frequently negative. Sometimes, however, the organism could be cultivated from the blood from twenty-four to forty-eight hours before death, and it could always be obtained from the blood a few hours before death. In many instances the bacteria are present in very large numbers in the blood, so that a diagnosis can often be made from a simple, microscopical examination. In no other disease is so marked a bacteræmia present. In the early stages of the disease cultures from the blood should be made in bouillon, as much as 1 cubic centimeter of blood being employed. The agglutination test is of no value in making a diagnosis, as the course of the disease is too acute and the patient has succumbed before the agglutinins appear in demonstrable quantities. The reaction of the deflection of the complement is also not to be recommended for the same reason; the examination of the sputum and blood for the presence of the bacillus gives much greater and more valuable information. In cases where

no necropsy is permitted and a post-mortem bacteriological diagnosis is advisable, microscopical examination of material, obtained by lung puncture with a syringe, may often be conclusive of pneumonic plague, *Bacillus pestis* being present in the microscopical preparation, in enormous numbers, in pneumonic-plague cases.

PROPHYLACTIC INOCULATIONS

Several methods of prophylactic inoculation were particularly recommended by their different advocates at the Conference. Among these were the methods of vaccination with living attenuated cultures, with plague nucleoproteid, and with killed bouillon and agar cultures of the organism. The conclusions submitted in regard to vaccination with living attenuated cultures were as follows:

1. Vaccination in plague with a properly attenuated culture is as harmless in human beings as vaccination against smallpox.
2. Such vaccination in man unquestionably gives rise to an immunity against bubonic-plague infection.
3. During the present epidemic, prophylactic inoculations by means of dead cultures very frequently have been shown to be ineffective against plague infection; some individuals inoculated three times have contracted the disease.
4. It should be one of the duties of this Conference to investigate thoroughly the question of true vaccination against plague.
5. A suitable culture for vaccination against plague should be recognized internationally as a standard culture and placed with some well-known bacteriological institute from which it can be obtained at all times.
6. Vaccination against plague with such a standard culture should alone be countenanced.

In regard to prophylactic injections of plague nucleoproteid, according to the method of Lustig and Galeotti, it was claimed that by this method (1) the pure toxin could be dried, weighed, and dissolved again in exact proportions, and (2) that only the toxin which produces the immunity was injected and no other pathogenic substance contained in the plague culture; therefore, the highest immunity and the smallest local and general reactions were obtained. Another advantage claimed for the plague nucleoproteid was that it could be easily obtained and its sterility preserved, and that it retained its immunizing properties for a considerable period.

All of the members of the Conference did not agree to *all* of the claims made for either of these methods.

In regard to the inoculation of killed cultures, it may be stated that 132 people were inoculated at the Russian Plague Hospital

at Harbin;[1] 22 of these contracted plague—13 after one injection, 8 after two injections, and 1 after three injections. Of the 8 who fell sick after two injections, 2 contracted plague six days, 2 ten days, 2 fourteen days, 1 twelve, and 1 twenty-seven days after the inoculation. Of the 13 who contracted plague after one injection, 12 contracted plague after two weeks and 1 after six days.

It was suggested that in some cases, in which the individuals who had been vaccinated had contracted pneumonic plague and died, their infection had occurred during the period of greater susceptibility to infection which followed the inoculation—that is, during the period of the negative phase, as it was called, and which, it was stated, lasted for about twelve days following the inoculation. However, the Conference did not consider that any definite evidence of the occurrence of such a negative phase after the inoculation of killed cultures existed.

At Fuchiatien, 439 individuals were inoculated with Haffkine's vaccine and with serum.[1] Sixteen individuals received three inoculations—two of Haffkine's vaccine and one of serum. None of these became infected. Thirty individuals received two injections, either with Haffkine's vaccine or with Haffkine's vaccine and serum. None of these, also, became infected. Of 393 individuals who were vaccinated once with Haffkine's vaccine, 4 died of plague—1 eight days, 1 ten days, 1 eighteen, and 1 thirty-two days after inoculation.

In the neighborhood of 14,000 individuals were inoculated with killed cultures of the plague bacillus during the epidemic, but a very large number of these individuals were never exposed to plague infection, and we, therefore, have no positive evidence as to what protection was conferred upon them by the inoculation.

After some discussion, the question of the value of the employment of prophylactic inoculations in pneumonic plague was referred to a special committee on the subject. In order that the reader may have as complete an idea as possible upon the views of the majority of the members of the Conference upon this subject, the conclusions reached by this committee and accepted by the Conference are presented here.

The statistical evidence points to the conclusion that some degree of protection is conferred against bubonic plague by the use of vaccines.

Therefore, there are *a priori* grounds for the use of inoculation with vaccines as a means of protection against pneumonic plague.

The statistics which have been collected during this past epidemic do

[1] Neither the number of those afterwards exposed to pneumonic infection nor the number who wore masks could be ascertained.

not allow us to come to any definite conclusion about the value of active prophylactic inoculation against plague pneumonia.

Many methods proposed for producing immunity against plague have been considered by this Conference; of these some have been already largely used on human beings; others are still under trial.

a. *Those already largely used are:*
   (1) Dead bacilli vaccines (*a*) Bouillon cultures.
   (*b*) Agar cultures.
   (2) Nucleoproteid vaccines.
   (3) Mixed dead bacilli and serum, combined.

b. *Those under trial:*
   (1) Living attenuated cultures.
   (2) Living cultures and serum, combined.

Dead bacillary vaccines can be simply prepared, and in one form or another have been used extensively in different parts of the world. There is a considerable amount of evidence to the effect that preparations of this kind confer some degree of protection against bubonic plague, and the method of agar culture affords some advantage in respect to quickness of preparation, and it is the opinion of the majority of this Conference that killed cultures represent at the present time the simplest, safest, and best method of vaccination against plague, and this opinion is expressed without prejudice to the use of other methods of vaccination or vaccination combined with serum-prophylactic, should such be proved to offer greater advantage.

Lustig and Galeotti's vaccine.—This preparation seems to have given excellent results experimentally on animals, and can be as safely used as other vaccines. It has the advantage that, without losing its properties, it can be conveniently stored in a dried form.

Strong's method.—This is worthy of careful consideration. The results obtained by experiments on animals and on human beings are so striking as to make it important to collect more evidence as to the safety of the method, as a practical prophylactic, on a large scale.

"We offer the following advice: 1. That experiments on animals (guinea pigs, white rats, and monkeys) should be carried on by the method of inhalation, in order to find out which vaccine can be best used against pneumonic plague.

"2. That, should another outbreak of pneumonic plague occur, the above methods of vaccination should be tried in selected communities (as in India) under rigorous, scientific conditions."

It was also resolved by the Conference that, until further statistics were available, the members of the sanitary staff should be inoculated as far as practicable with plague vaccine before commencing their duties.

In regard to the suggestion that experiments in the immunization of guinea pigs and monkeys should be carried out and their immunity tested by their exposure to the inhalation of plague bacilli, in order to find out which vaccine could be best used against pneumonic plague, it may be stated that since the Conference, Teague and the author have vaccinated large numbers of guinea pigs and monkeys with a living attenuated plague

culture. These animals were later exposed to infection by inhalation, the same number of unvaccinated control animals as vaccinated ones being exposed at the same time in each series. The experiments have shown that in the case of guinea pigs 75 per cent of the vaccinated animals proved to be immune when exposed to infection by inhalation. However, the unimmunized (control) guinea pigs, when exposed to infection, frequently died not of primary pneumonic infection but of primary bubonic infection of the glands of the neck and of secondary septicæmia and sometimes secondary pneumonia. In only a small percentage did the animals die of primary plague pneumonia. So that these experiments with guinea pigs have merely demonstrated that about 75 per cent of these animals which had been vaccinated was immune against the entrance of infection through the mucous membrane of the mouth and throat.

In the case of monkeys which when unimmunized and exposed to inhalation almost invariably die of primary pneumonic infection, only about 10 per cent of the vaccinated animals was protected against infection by inhalation.[1]

It, therefore, appears that even *vaccination* against pneumonic plague with a living attenuated culture affords, in animals at least, a very uncertain means of protection against this infection. (See p. 116.)

SERUM-THERAPY

Prophylactic use.—Reasoning *a priori* from the amount of serum required to protect animals against pneumonic-plague infection, much larger doses of the serum would be required to protect human beings against pneumonic infection than have frequently been employed to protect against bubonic infection. Doses as high as 1,000 cubic centimeters for a patient of 60 kilograms weight might be indicated; a smaller dose than 100 cubic centimeters should not be employed. In animals the protection afforded by serum against pneumonic infection did not last longer than five days. The serum exercised no curative effect after the infection had developed, the animals always eventually succumbing, although occasionally life was prolonged. During the epidemic, when the serum was injected during the incubation period, in several of the patients it did not prevent the usual development and progress of the infection. In a few cases, in which individuals were inoculated with from 40 to 150 cubic centimeters, the serum seems to have exerted a prophylactic effect, but in other instances, inoculated in the same way, such a protective effect was not observed.

[1] For a full report of these experiments see *Phil. Journ. Sci.;* article in press.

In regard to the *serum treatment* of the disease, it may be stated that the serum in some instances appeared to have prolonged somewhat the life of the patient. Of 42 human cases of pneumonic plague, treated with antiplague serum during the epidemic, 33 were taken from the isolation wards, and the first injections with the serum were made not later than six hours after the first symptoms of the illness had appeared. The remaining 9 received the injections with serum on the second day of the disease. All of them died of pneumonic plague. The injections were given both intravenously and subcutaneously; no difference in the course of the disease was observed with either of these methods. The quantities of serum injected varied from 100 to 1,700 cubic centimeters. In the early stages of the disease, the serum appeared to cause a fall in temperature and a temporary improvement in the general condition of the patient. The fall in temperature usually occurred during the first three hours after the injection, and lasted for from six to twelve hours. Sometimes the temperature fell from 0°.5 to 2°.5 C. after the injection. After the fall, the temperature again suddenly rose. Sometimes following the injection the pulse became slower and stronger. The injection of serum did not prevent the development or extension of the pneumonia to other lobes of the lung unaffected at the time of the injection, nor did it prevent the development of septicæmia. After septicæmia had developed, the serum seemed to exert no favorable effect whatever upon the patient. Only when given in the early stages of the disease did it appear to prolong the illness.

All of the cases at Harbin and elsewhere during the epidemic which were treated with serum died, with the exception of three cases reported from Dairen. These three cases, which were reported with the diagnosis of pneumonic plague, each received about 240 cubic centimeters of serum, in divided doses. In one of the cases diagnosed as pneumonic plague, *Bacillus pestis* was not present in the sputum at the time the serum was given. The diagnosis of pneumonic plague was not completely confirmed by a bacteriological examination in these cases, and the general consensus of opinion at the Conference was that they could, therefore, not be considered definitely as cases of pneumonic plague. It is true that the microscopical examination of the sputum had revealed the presence of bacilli which appeared similar in morphology to *Bacillus pestis* and that an agglutinative reaction was present in these cases; the agglutinative value of the serum of the patients appeared to be exactly the same as in the case of the serum injected (see Part I, pp. 133 and 134).

The general experience throughout the epidemic, therefore, was that no method of treatment has been of any value in saving life, and that the serum treatment seems only in a few instances to have prolonged the duration of the illness.

MORBID ANATOMY ESPECIALLY IN RELATION TO THE MODE OF INFECTION

Very few contributions to the literature upon the pathological anatomy of primary pneumonic plague have hitherto been made, and none of these have been based upon the study of extensive material. This subject, therefore, is one of particular importance in connection with the present epidemic. For a more complete idea of the pathological anatomy of the disease, the reader is referred to the three articles on this subject in Part I, pages 135, 144, and 151.

In the present summary, a brief discussion of the mode of infection and of the changes in the lung will chiefly be given.

Two opinions were submitted in the evidence before the Conference regarding the mode of infection in pneumonic plague.

It was claimed by one observer that pneumonic plague is primarily a septicæmic disease, the lungs becoming secondarily involved by way of the blood circulation, the great accumulation of plague bacilli sometimes found in the perivascular spaces being a condition supporting this conclusion. From the perivascular spaces, the infection was supposed to spread to the neighboring lung alveoli. According to this same observer, the bacilli enter the blood by the lymphatic vessels through the lesions in the tonsils and are deposited in the interstitial tissues around the lung alveoli, the tonsils being regarded as the primary point of infection. In some instances it was assumed to be possible for the plague bacilli to pass from the mucous membrane of the trachea and bronchi to the neighboring lymphatic glands and from them to enter the blood and in this way later to reach the lung.

According to the other more generally accepted view, epidemic plague pneumonia results from inhalation, the primary point of infection being not the tonsils but some portion of the bronchi.

Whether the plague bacilli penetrate at once to the terminal bronchi and alveoli or whether they pass to the lung tissue by the lymphatics through the mucous membrane of the lower portion of the trachea or larger bronchi can not be stated definitely from the evidence presented before the Conference.

More complete microscopical studies are necessary further to elucidate this point.[1]

Having reached the finer bronchi, the bacilli rapidly multiply and produce at first pneumonic changes of the lobular type and shortly afterward more general lobar involvement of the lung tissue.[2]

The blood becomes quickly infected and a true bacteræmia results in every case. The fact that the bronchial glands at the bifurcation of the trachea are always much more severely affected than any of the other lymphatic glands argues against the theory that epidemic pneumonic plague is primarily a septicæmic disease and that the lungs are infected secondarily from the blood. Moreover, in the earliest stage of the disease, the blood may be free from plague bacilli.

It is true that in some instances the bacteræmia occurs early in the course of the disease and before hepatization of the lung may have taken place. However, microscopical examination will reveal enormous numbers of plague bacilli in the engorged lung tissue from which it appears that the origin of the bacteræmia is clear.

The tonsils may become secondarily infected in pneumonic plague just as other lymphatic glands—for example, the bronchial ones—become so infected. However, in pneumonic plague death usually occurs before any very marked macroscopic changes occur in the tonsils. There is no doubt also that the tonsils may become primarily infected in epidemics of pneumonic plague just as has occurred in sporadic cases in epidemics of bubonic plague. This, however, is not the common channel of primary infection, and in such cases involvement of the glands of the neck occurs early in the course of the disease. Such cases are really instances of bubonic plague in which the lungs may, or may not, become secondarily infected.

In some instances, as has been shown by recent animal experiments, plague infection may occur directly through the mucous membrane of the mouth and throat. Primary septicæmia then results. In those instances in which the infection is virulent and severe and the susceptibility of the animal marked, death

[1] These are at present being made by Teague, Crowell, and the writer, and will shortly be published in the *Phil. Journ. Sci.*

[2] Extensive experiments performed in the Biological Laboratory of the Bureau of Science, Manila, by Dr. Teague and the writer, since the Conference, in monkeys experimentally infected with pneumonic plague have confirmed the fact that the pneumonia is usually primarily bronchial in origin. For a complete report of these experiments see *Phil. Journ. Sci.;* article now in press.

may sometimes occur before bubonic involvement is apparent. In other instances septicæmia and bubonic involvement of the glands of the neck are present. No true pneumonia occurs unless infection by inhalation has in addition taken place.[1]

The *lungs*.—After death from pneumonic plague, the lungs in general are very rich in blood and appear dark red and usually œdematous. Some portion of the lung shows either pneumonic infiltration or engorgement. The pneumonic areas are either lobular or lobar in type. In the former instance, one or several nodules, measuring usually from one to several centimeters in diameter, may be found in the lobe. Sometimes these nodules are arranged along the bronchus as flowers on a stem. These areas are usually rather sharply circumscribed, from the surrounding lung tissue, by a more or less marked ring of engorgement, and may be either circular in outline or wedge-shaped. They no longer contain air. On cut section, the surface is rather dry, either dark red or grayish-red in color and granular in appearance. On pressure, no mucus plugs are expressed from the bronchi, as is frequently the case in bronchial pneumonia due to infection with microörganisms other than the plague bacillus. The mucous membrane of the bronchi leading to these areas is frequently dark red in color.

In the lobar type of pneumonia, which is much more frequently encountered at necropsy, the whole lobe of the lung, or a portion of it, may show only pneumonic engorgement; smaller or larger areas of red or beginning gray hepatization may in addition be present. The condition in which the entire lobe is in the stage of gray hepatization, such as is seen in ordinary croupous pneumonia due to *Diplococcus pneumoniæ*, has not been encountered, as the patients die before this stage is reached. However, a small area of gray hepatization, adjoining one of red hepatization and this in turn shading into an area showing only engorgement, is frequently observed. Sometimes death occurs before any apparent hepatization has taken place and when only a portion of the lung is engorged and markedly œdematous. Even in these instances, however, enormous numbers of plague bacilli are found in the lung tissue. In those instances where only one lung is pneumonic, the other usually shows marked congestion and œdema. In some of the cases both types, the lobar and lobular, are encountered. The absence or scarcity of fibrin in the alveolar exudate is in striking contrast to the condition ob-

[1] For a complete report of these experiments see the article in the *Phil. Journ. Sci.* already referred to.

served in croupous pneumonia. The alveoli are frequently filled with plague bacilli. These organisms are also found in large numbers in the perivascular and peribronchial lymph vessels.

The mucous membrane of the bronchi is, in almost every instance, of a bright-red color. The bronchi contain a frothy, bloody, serous fluid or more rarely a reddish mucus exudate. Fresh, fibrinous pleurisy is almost universally observed over some portion of the pneumonic areas. Numerous ecchymoses beneath the pleura are also almost always encountered, and vary only in number and extent.

The mucous membrane of the mouth and throat, over the base of the tongue, uvula, tonsils, and adjacent structures is in all cases somewhat swollen and generally appears of a more or less dark-red or reddish-purple color. The larynx and trachea are also markedly hyperæmic. The bronchial lymphatic glands, near the bifurcation of the trachea, always show more advanced changes than any of the other lymphatic glands. They are always swollen and almost black in color, partially from the hæmorrhages which have occurred into the glandular substance. The lymphatic glands along the lower portion of the trachea are also usually swollen and sometimes contain hæmorrhages. The other lymphatic glands of the body are usually normal in appearance.

The right chambers of the *heart* are usually distended with blood. The heart muscle invariably shows cloudy swelling. Microscopically, fragmentation is often observed.

Numerous ecchymoses are particularly found in the parietal pleura covering the thoracic wall, diaphragm, and pericardium, and larger extravasations of blood frequently occur about the vessels posterior to the peritoneum and in the region of the kidneys, omentum, and mesentery. The bronchial veins sometimes show hæmorrhages in the intima. Numerous hæmorrhages may also be found elsewhere about the smaller veins throughout the body.

The *spleen* is moderately enlarged in about 50 per cent of the cases. It is very firm, the red pulp is greatly increased, and the follicles and trabeculæ are usually not clearly visible. Small hæmorrhages sometimes occur in the spleen.

The *kidney* usually shows punctiform hæmorrhages in the capsules and deep injection of the surface vessels. The kidneys are rich in blood and show either parenchymatous or fatty degeneration. The glomeruli are frequently swollen.

The *liver*, also, usually shows cloudy swelling or early fatty degeneration.

Distribution of the plague bacilli.—At necropsy the plague bacillus is invariably found present in the blood. The bacilli are always much more numerous in the lungs and in the bronchial lymphatic glands at the bifurcation of the trachea than in any of the other organs or in the blood. In the lungs they are found frequently lying together in great masses. They are always more numerous in the spleen than in the blood. In no other disease are such masses of bacteria encountered in the lung. In the tonsils the number of plague bacilli is small, usually not more are found than are observed in the blood.

CHAPTER IV

CONNECTED NARRATIVE BASED ON THE TESTIMONY PRESENTED BEFORE THE CONFERENCE: I. MEASURES EMPLOYED TO COMBAT THE EPIDEMIC; II. THE EFFECT OF THE EPIDEMIC ON TRADE

By Dr. Arthur Stanley

MEASURES EMPLOYED TO COMBAT THE EPIDEMIC

Measures preventive of plague are difficult to put into operation in any country where plague suddenly breaks out; and this was especially the case in China, owing to the general absence of knowledge regarding modern sanitation both among the people and the officials, who found themselves quite unprepared for an epidemic of such appalling virulence. As no such epidemic of exclusively pneumonic plague had taken place in modern times. the lack of sanitary precautions, which could readily be put into practice, was to some extent excusable and the subsequent success of the campaign all the more creditable not only to the officials responsible but to the intelligence of the people, who, after a

period of active resistance to measures which involved self-sacrifice, wholeheartedly assisted the sanitary authorities. Modern hygiene has no place in the old Chinese system of the medical art. As in Canton, Hongkong, and Shanghai, the people in Manchuria at first resisted plague-preventive measures. It may be noted that most of the natives of Manchuria lead simple, rustic lives, with little knowledge of the outside world.

As the Conference considered the epidemic chiefly from the point of view of the future, the testimony regarding the measures actually taken to combat the past epidemic was somewhat meager and lacking in details.

In view of the entire absence of bubonic cases of plague throughout the epidemic and no infection being found among some 50,000 rats examined for plague in Manchuria, the measures for combating the epidemic were largely applicable to the pneumonic form of plague only, the troublesome question of dealing with rats being eliminated.

PROPHYLACTIC INOCULATIONS

The detailed consideration of the question of prophylactic inoculation was undertaken by a special committee of the bacteriological and pathological section. Here, therefore, it will only be necessary to refer to the practical application of the resources of the bacteriological laboratory for prophylactic purposes. The use of killed cultures of the plague bacillus was rather general, as is shown from the fact that the Chinese Government is reported to have spent $100,000 on these products. Plague vaccination was offered to the public free of charge in most places where plague broke out. There can be no doubt that the death, early in the epidemic, of Dr. Jackson, who was injected once with some two-year-old Bombay "vaccine," which gave practically no reaction, had a deterrent effect on the subsequent use of protective inoculation; while, after several of those who had been "vaccinated" with recent "vaccine" had fallen victims to pneumonic plague, many relied almost exclusively on the use of the mask for protection.

From the evidence presented, it was not possible to draw definite conclusions as to the value of protective inoculation against plague pneumonia; but the general opinion was that the infection was too massive when the lungs were involved for the ordinary methods at present in use to be of much value. The method of inoculation which received most approval was to give an injection corresponding to 6 milligrams of dead bacilli subcutaneously, followed after eight days by double that quantity.

Regarding hypersusceptibility to infection immediately following protective inoculation, no positive evidence was given which tended to show that there was a negative phase following the use of "vaccines."

No new facts were brought out regarding either local or constitutional effects produced by vaccines and sera from different sources. Neither from the testimony given could conclusions be drawn as to the value of antiplague serum as a prophylactic against plague pneumonia either given alone or with "vaccine," but the opinion was expressed that the use of serum on a large scale for prophylactic purposes was prohibitive on account of costliness. The use of serum combined with "vaccine" was little used and not generally recommended.

MEASURES TAKEN TO LIMIT THE SPREAD OF INFECTION IN AN INFECTED TOWN OR VILLAGE

SANITARY CORDONS

Sanitary cordons, although a hindrance to economic life, were found necessary, especially in small places, under present conditions in Manchuria. In the case of cities surrounded by a wall, this boundary proved of considerable value. The Great Wall of China, from the mountains to the sea at Shanhaikuan, was easily watched by 750 soldiers, owing to the small number of inlets, and no case of plague was reported as having passed through this ancient barrier, though this was due rather to the restriction of passenger traffic on the railway. In the case of the walled city of Mukden, a guard was placed at each of the eight gates and an efficient cordon furnished by a handful of police, but in Changchun there was no wall and the city was too large for the use of a cordon. Around Fuchiatien, a town of some 25,000 inhabitants, which has no wall, there was a cordon of 1,160 soldiers to prevent ingress and egress of carts and passengers, unless provided with permits from the Antiplague Bureau.

MEASURES LIMITING INTERCOMMUNICATION OF MEMBERS OF THE COMMUNITY

When plague broke out in a town, all communications were, as far as possible, cut off from the infected district. When the outbreak assumed epidemic proportions, it was found necessary to close public meeting places such as theaters, fairs, churches, and schools. As most of the cases of plague came from inns, lodging houses, tea houses, and beggar resorts, these places were kept under constant medical supervision or closed, and the occupants transferred to extemporized night refuges and eating houses. Public processions were stopped.

As it was practically impossible to stop the rickshaw and cart traffic, inspection and disinfection was done so as to limit the traffic as much as possible. In Mukden the rickshaws which had been inspected were given flags to carry. At Dairen, during the epidemic period, coolies were not allowed to use rickshaws or tram cars. In Harbin the workmen of large factories lived under supervision in or near the factory specially segregated; otherwise the factory was closed.

The division of towns into sections and the segregation of the inhabitants in each section with the enforcement of quarantine regulations was found to be of value for limiting the infection. This was especially true in Fuchiatien, which was divided into four sections, each inhabitant, when outside, being required to wear a colored badge around the arm, corresponding to the section in which he lived, and a special permit being required for him to leave that section.

SANITARY EDUCATION OF THE PEOPLE

The education of the people by means of public lectures and the issue of pamphlets, posters, and popular bulletins, explaining in simple language the nature of the disease and the measures to prevent its spread and urging all to help the authorities by notifying cases, was found of great value. In Mukden a "plague" newspaper was published daily which contained news regarding the general progress of the epidemic and the meaning of the preventive measures. The general newspaper press proved of value in spreading news of the progress of the epidemic and the preventive measures, so that people in other places, being forewarned, were better prepared to protect themselves. This tended to make the sanitary authorities and the people work together.

THE ESTABLISHMENT OF HOSPITALS

Early isolation of the first cases and of persons who had been in contact with them was found to stop the spread of pneumonic plague with the greatest ease, except in places like Changchun where, having no sanitary cordon, owing to the difficulty of guarding the city wall, there was a continual influx of sick from infected surrounding villages. Hospitals were established wherever any considerable number of cases occurred. In Mukden a temple was rapidly converted for the reception of plague cases, pending the erection of wooden barracks. It was early recognized that separate isolation was necessary for the comparatively large number of cases, suspected of plague, before the diagnosis could be confirmed by bacteriological examination.

The extremely rapid, fatal termination of cases of pneumonic plague (average duration: one to one and one-half days) gave rise to entirely new hospital requirements. It was found best to place the suspected cases in separate rooms near the wards where plague cases were. At first the tendency was to have the plague hospital too far away from the town, which unnecessarily increased the difficulties of transport. As a rule large numbers of patients were placed together, as the onset of the epidemic was too rapid to permit of the ideal plan of individual isolation. Experience showed that the Chinese made good nurses. The difficulties under which the hospitals were erected were often very great on account of snow and the frozen ground.

THE ESTABLISHMENT OF QUARANTINE STATIONS

Early in the epidemic it was recognized that the main problem of prevention was the limitation of the movements of coolies in the incubation period of plague. Quarantine stations for persons who had been in contact with cases of plague were therefore instituted. These *contact quarantine stations*, where suitable buildings, which could be converted to their use, were not available, were mostly buildings of a barrack-like nature divided by partitions as far as possible. The quarantine period varied from five to seven days. In Fuchiatien and in places along the Russian railway line, railway wagons were used and they were found to possess the following advantages, namely: readily procurable, moveable, easily fitted up with bunks at the ends, easily ventilated and heated, and easily disinfected by turning a locomotive steam pipe into them. In Mukden there was a contact quarantine station in each of the sanitary districts. The inmates of these stations were medically inspected, temperature and pulse being taken once and where possible twice daily, so as to discover fresh cases and secure their early isolation. The evening was found to be the best time for inspection. As regards the number of persons quarantined together, it was naturally found that the greater the aggregation the greater the number infected.

For certain classes of the community, such as beggars and waifs, and for immigrants, *segregation stations* were instituted. For this purpose empty warehouses, railway cars, or rapidly erected wooden barracks were employed, mostly in the form of large wards. The cases of plague were largely restricted to the coolie class and the lowest orders. Night refuges were established and were found useful for bringing the most susceptible class under supervision. In Manchouli station, where the Chinese revolted against compulsory house-to-house inspection and isola-

tion and concealed their cases and the deaths, the epidemic was not stamped out until the whole of the Chinese population, with the exception of a few families, who live under healthy conditions, were segregated and kept under strict surveillance and medically inspected twice daily.

NOTIFICATION OF CASES AND REGISTRATION OF DEATHS

Considerable difficulty was experienced in locating plague cases and deaths, there being no proper system of notification of dangerous infectious diseases or registration of deaths. Every conceivable plan was at first used by the people for hiding cases and dead. Persons sick or dead of plague were frequently thrown out into the streets or dumped in the fields. It became necessary, therefore, to adopt house-to-house visitation. This was done daily, where possible, by a staff consisting of a doctor or a medical student, two sanitary coolies, and two policemen or soldiers to ensure compliance with orders. Where coöperation was given by the residents the system worked well, but where cases and deaths were concealed, as at Manchouli station, nothing short of evacuation in mass and segregation under medical supervision proved effectual. Inspection of the coffin shops was undertaken, and the number of coffins sold gave a rough indication of the number of deaths occurring. In Peking, Mukden, and a few other places a system of death registration was put into force. In Changchun heavy fines were inflicted for not notifying cases. In Chefoo house-to-house visitation was not permitted, and the epidemic lasted longest there.

The innate intelligence of the Chinese people was shown by the circumstance that when the reason for the preventive measures became known, villages, of their own initiative, cut themselves off from the outside world, sending one man and a cart to procure daily the necessary supplies.

DISINFECTION

No evidence was furnished to the Conference to show that persons contracted plague from going into houses which had not been disinfected.

The burning of houses, carbolic spray, sublimate swabbing, and sulphur fumigation appeared to be the chief methods of disinfection used. Five thousand pounds of carbolic acid were used in Fuchiatien alone. None of the new, high-power coal-tar disinfectants appears to have been available. Steam was used for disinfecting in railway cars, while small, moveable, steam disinfectors were used in Mukden and in a few other places. Lime was used for floors and in coffins. One in 3,000 sublimate

solution was used for disinfecting baths. The use of disinfectant on masks was, after a time, considered unnecessary. The general opinion was that fumigation with sulphur or formalin was difficult of application in Chinese houses. The disinfection of mails, carried out at first, was subsequently considered unnecessary.

DISPOSAL OF PLAGUE CORPSES

As the ground was frozen hard for some considerable depth, the burying of bodies was difficult. Near many places thousands of dead bodies, many without coffins, accumulated in the open. Cremation, a method of disposal particularly repulsive to the religious feelings of the people, was recommended from a sanitary point of view and the recommendation supported by many of the officials, who persuaded the people to submit. Thus an almost revolutionary measure was put into operation among this most conservative people as a result of their innate, practical common sense. Thousands of bodies were thus rapidly and safely disposed of. In Fuchiatien plague corpses when found were wrapped in coarse sheets soaked in sublimate solution and removed in special, metal-lined, covered carts to the cremation pits, where they were burned with wood and kerosene oil; the coffins and bodies with logs of wood being piled up, arrangement being made to secure an underdraught, and kerosene oil being pumped on with a hand pump. At Harbin disused brick kilns furnished very efficient cremation furnaces, in each of which over a hundred bodies could be reduced to ashes in a few hours. The coolies, who attended the dead carts and cremations, were found not to contract plague as a direct result of their work. They did not handle the uncoffined bodies more than was absolutely necessary, but used long, blunt, iron hooks to facilitate their removal. In view of the length of time plague corpses may remain infective, cremation appealed to most of the local authorities as the quickest, safest, and most economical mode of disposal of the dead. In some places, however, the prejudices of the people outweighed their common sense. At Mukden, the dead were buried in deep pits, after being promptly coffined with lime according to the customary Chinese method. On the other hand, in some villages the people burned their dead on their own initiative, following the example set them in the cities.

ORGANIZATION OF THE SANITARY STAFF

As an example of sanitary organization may be taken that in Fuchiatien, a place with a population of about 25,000. The medical staff consisted of 53 doctors and medical students. A central antiplague bureau was instituted, together with a plague

hospital and a quarantine station for contacts, railway cars being used for this purpose.

A military cordon was thrown round the town outside the boundary and formed by 1,160 soldiers quartered in an empty flour mill. The soldiers were divided into four groups each doing six hours' cordon duty daily in large sentry boxes which afforded suitable protection against the intense cold. No person was allowed to pass the cordon except with a permit from the Anti-plague Bureau.

The town was divided into four sections and a sectional cordon formed by 600 police who enforced quarantine measures. There was a quarantine station, a sanitary office, and disinfecting station in each section. The inhabitants were limited each to their section and wore armlets colored according to the section. The staff of each section consisted of 1 medical officer; 2 assistant medical officers; 4 medical students; 58 sanitary coolies, divided into house-searching parties, disinfectors, stretcher bearers, and carriers of dead; and 20 policemen.

House-to-house visitation was done by a doctor or medical student, who was assisted by sanitary coolies and ambulance men, together with a couple of policemen to enforce compliance with his orders.

PRECAUTIONS TAKEN BY THE SANITARY STAFF

Practically all hospital and sanitary staffs were immunized with Haffkine's prophylactic; but when many subsequently died it was realized that far greater immunity was conferred by the careful use of a proper mask. After an extensive trial of many kinds of masks for protecting the respiratory tract against plague pneumonia, the opinion was almost unanimously in favor of a mask consisting of a cotton-wool pad broadly folded in plain gauze ending on each side like a three-tailed bandage, one tail tied below, one above the ear, and the middle tail tied above the head, like a jaw bandage, to keep the pad from slipping down; and in addition a cotton-wool plug placed within the upper margin of the pad on either side of the nose to fill up the open angles. Such a pad exerted a gentle pressure all round the entrances to the respiratory tract, cost but 2½ cents or one half-penny [$0.01 United States currency], and was easily made.[1] The use of the mask was found imperative for plague patients and suspected cases, as well as for nurses and others in close contact with pneumonic plague cases. The use of antiseptic gauzes and antiseptics on masks was found unnecessary, the action of the mask

[1] See footnote No. 1, Part II, Interim Report, page 394.—[EDITOR.]

being purely mechanical, filtering septic matter much in the same way that a cotton-wool plug keeps a culture tube sterile. The careful use of the mask appeared to confer absolute protection, and the deaths among medical men at the beginning of the epidemic were due either to not using masks or wearing imperfect masks.

Although the proper use of the mask was found of paramount importance for preventing infection, overalls, with or without a hood, rubber gloves and top boots were found useful, while for those in immediate contact with patients the use of goggles to prevent infection through the conjunctiva was considered necessary.

Additional precautions taken among sanitary staffs included complete change of clothing and a bath of 1 in 3,000 sublimate, after gargling the throat with an antiseptic, at the end of each period of duty. Mats soaked in carbolic lotion were sometimes used at the doors of hospitals.

MEASURES TAKEN TO PREVENT WIDESPREAD DIFFUSION OF INFECTION

Besides the quarantine measures taken at the recognized ports and along the railways, the cordon on the Great Wall, the Russian and Japanese cordons around the territories controlled by those nations, and the limitations of traffic by quarantine measures in the various towns did much to limit the widespread diffusion of infection; but in midwinter all the roads in Manchuria are at their best, and there was a great volume of traffic, so that the spread of the epidemic apart from the railways is not to be wondered at.

RAILWAY QUARANTINE

The first preventive measures taken on the railways were the medical inspection of passengers at the more important stations and the isolation of those found infected. These measures were soon found insufficient to prevent the carriage of plague by those in the incubation period of the disease. Quarantine stations, capable of holding from 500 to 5,000 persons, were then established at the more important stations wherein the traveling coolies were detained under medical supervision of from five to seven days and were proved to be free from infection before being permitted to take train; coolie traffic was stopped until these quarantine stations were ready. The sale of railway tickets was stopped at stations which had no arrangements for medical inspection and quarantine. As a result of these restrictions, large numbers of persons, who wished to get home in time for the New

Year festivities, took to the road and spread the epidemic southward.

For the protection of Peking, Tientsin, and the south a quarantine station was established on the railway at Shanhaikuan where all passengers were detained seven days under observation. On several of the railway systems radiating from the infected zone, second- and third-class traffic was completely suspended.

RIVER QUARANTINE

As the rivers were frozen during the epidemic, quarantine measures did not assume importance. Preparations were, however, made for the establishment of quarantine stations on the right bank (Chinese side) of the Amur and supervision by sanitary cruisers. Steamers on the Amur were to have a special compartment for isolation, while those on the Sungari had to tow a barge after them for isolation purposes.

SEA QUARANTINE

At Dairen passengers were kept under medical supervision for seven days and were proved to be free from infection before embarking for other ports.

Ships from ports in north China, which were plague infected or in close communication with the plague-infected *hinterland*, were required at Shanghai to undergo medical inspection and remain under surveillance at the quarantine station for the unexpired period of seven days after leaving the last plague-infected port, except where first-class passengers only were carried, who had proper certificates that they had been kept under medical observation for five days at Dairen, Tientsin, and Chefoo, respectively, before embarcation. Through passengers from Europe via Dairen where not required to be detained anywhere. As regards merchandise, the only Manchurian produce affected was furs, skins, and hair from plague-infected ports, which were permitted entry into Shanghai if accompanied by a proper certificate of disinfection. Coffins containing corpses were not permitted entry. Mail bags were disinfected with formalin by order of the postal authorities, though this was considered unnecessary by the sanitary officers. Generally the measures taken were such as would prevent the entry of pneumonic-plague cases or of persons in the incubation stage.

THE EFFECT OF THE EPIDEMIC ON TRADE

No statistical evidence regarding the effect of the epidemic on trade was furnished to the Conference. There was no doubt, however, that enormous stocks of beans and other produce ac-

cumulated, owing mainly to the shortage of labor through death, fright, and quarantine, and to the temporary stoppage of the railways. There was no evidence to show that pneumonic plague had been introduced into a noninfected port by infected materials. Except as regards furs, skins, and hair from plague-infected ports, no special restriction was put upon Manchurian produce. Tarbagan skins were permitted entry into Russia if it could be positively shown by consular certificate that they were from an uninfected region, otherwise it was necessary to disinfect them. Beans and grain could only be imported into Russian territory in new bags. There was no positive evidence that inanimate objects carried the infection of pneumonic plague and, therefore, it was considered undesirable in respect to pneumonic plague to restrict the transit of goods or mails, especially as no plague infection of rats was reported.

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[1] Numbers included in brackets refer to testimony regarding preparation of resolutions in Part II.—[EDITOR.]

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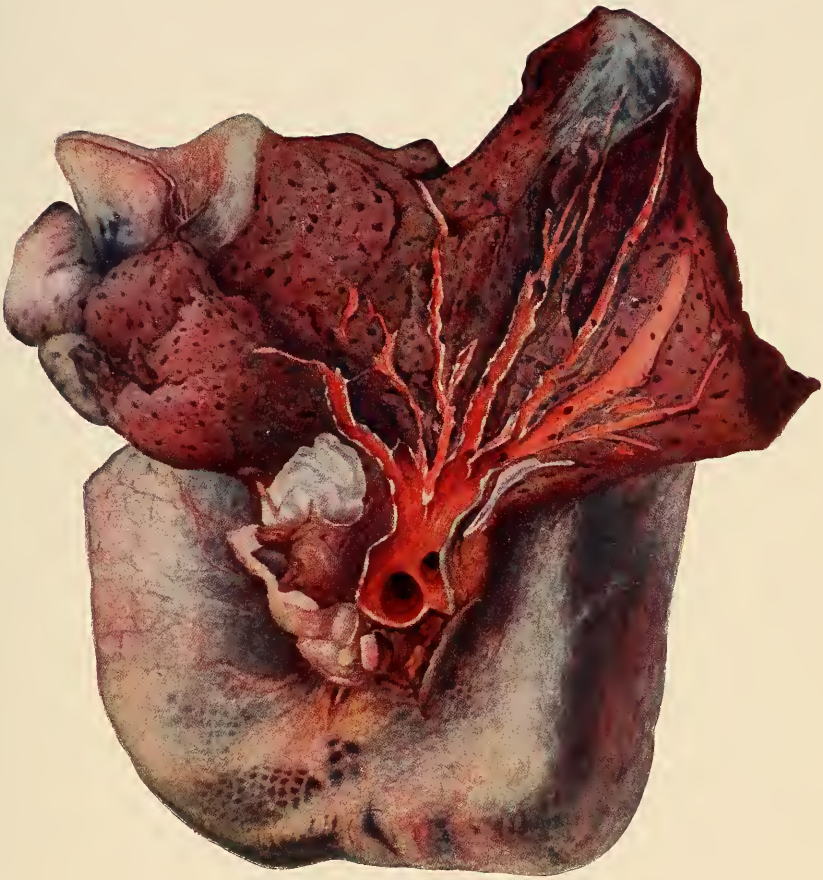

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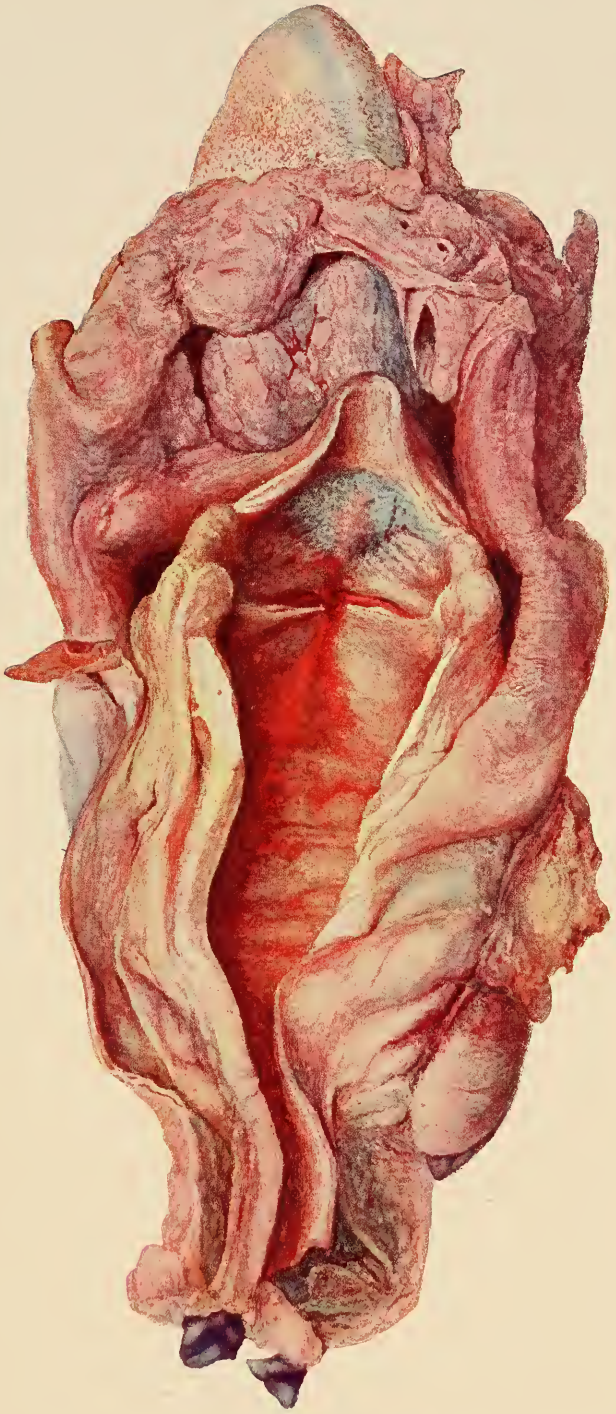

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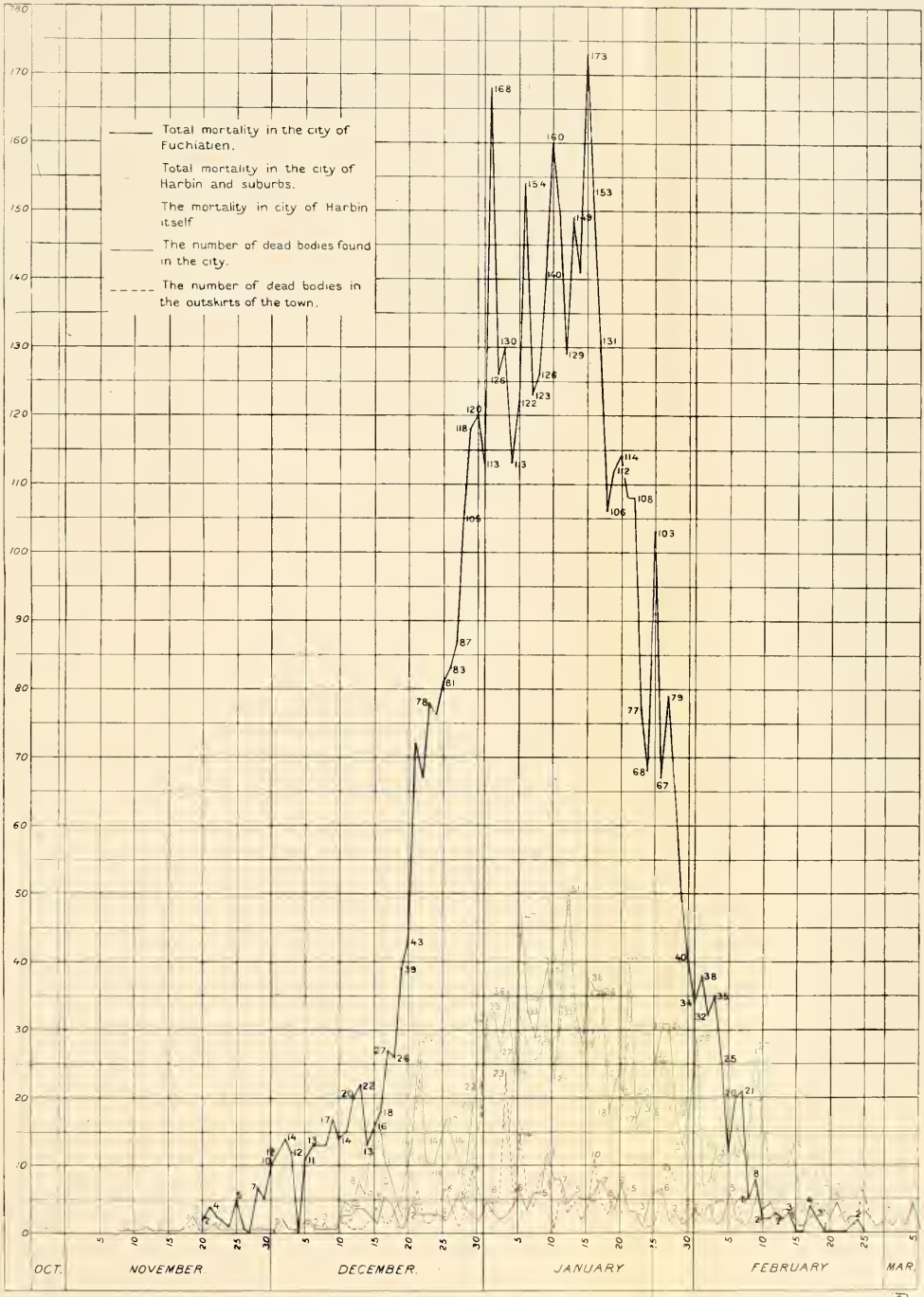

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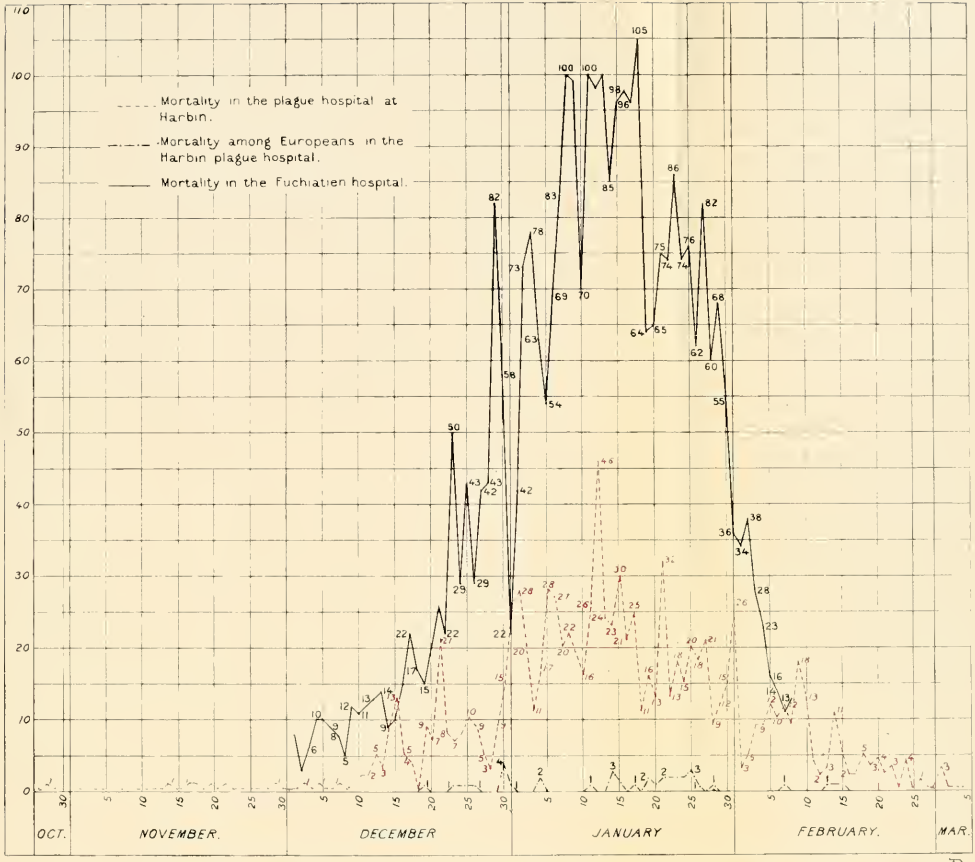

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Table showing the number of deaths in the plague hospitals and the number of dead bodies found in the city of Harbin and its suburbs, by weeks and months, from the beginning of the epidemic on October 27, 1910, until March 4, 1911, when it ended.

Week.	Date of month.	24-hour periods. Within the limits of the town. Died in plague hospital.	Dead bodies found in the town.	Total number of deaths from plague in the town.	Deaths from plague among Europeans.	Dead bodies found in the suburbs.	Total deaths from plague in Harbin and its suburbs.
I	Oct. 27	1		1			1
	28						
	29						
	Total	1		1			1
II	Oct. 30						
	31						
	Nov. 1						
	2						
	3						
	4						
	5						
	Total						
III	Nov. 6						
	7						
	8					1	1
	9						
	10						
	11		1	1			1
	12						
	Total		1	1		1	2
IV	Nov. 13	1		1	1		1
	14						
	15						
	16	1		1			1
	17	1		1			1
	18		2	2		1	3
	19	1		1			1
	Total	4	2	6	1	1	7
V	Nov. 20						
	21	1	1	2			2
	22						
	23						
	24						
	25						
	26						
	Total	1	1	2			2
VI	Nov. 27					1	1
	28	1		1			1
	29						
	30						
	Dec. 1		2	2			2
	2	1		1			1
	3						
	Total	2	2	4		1	5
VII	Dec. 4	1	1	2			2
	5		1	1		1	2
	6						
	7	1		1		1	2
	8						
	9	1		1			1
	10	2	2	4		1	5
	Total	5	4	9		3	12
VIII	Dec. 11	2	2	4			4
	12	5	3	8			8
	13	3	3	6			6
	14	9	2	11		2	13
	15	13	1	14		4	18
	16	5	5	10		1	11
	17	4	3	7		1	8
	Total	41	19	60		8	68
IX	Dec. 18					4	4
	19	9		9	1		9
	20	7	4	11		3	14
	21	21	2	23		6	29
	22	8	2	10		1	11
	23	7	2	9	1	1	10
	24	8	2	10	1	4	14
	Total	60	12	72	3	19	91
X	Dec. 25	10	1	11	1	6	17
	26	9	3	12	1	2	14
	27	5	5	10			10
	28	3	3	6		4	10

(Continued.)

Table showing the number of deaths in the plague hospitals and the number of dead bodies found in the city of Harbin and its suburbs, by weeks and months, from the beginning of the epidemic on October 27, 1910, until March 4, 1911, when it ended—Concluded.

Week.	Date of month.	24-hour periods. Within the limits of the town. Died in plague hospital.	Dead bodies found in the town.	Total number of deaths from plague in the town.	Deaths from plague among Europeans.	Dead bodies found in the suburbs.	Total deaths from plague in Harbin and its suburbs.
X	Dec. 29	9	2	11	----	9	20
	30	15	1	16	4	6	22
	31	26	4	30	1	2	32
	Total	77	19	96	7	29	125
XI	Jan. 1	28	2	30	----	3	33
	2	20	1	21	----	6	27
	3	11	2	13	----	23	36
	4	17	3	20	2	4	24
	5	28	5	33	----	14	47
	6	26	2	28	----	5	33
	7	20	5	25	----	4	29
	Total	150	20	170	2	59	229
XII	Jan. 8	22	5	27	----	8	35
	9	20	11	31	----	9	40
	10	16	7	23	----	----	23
	11	26	7	33	1	6	39
	12	46	3	49	----	2	51
	13	24	5	29	----	4	33
	14	23	4	27	3	1	28
	Total	177	42	219	4	30	249
XIII	Jan. 15	30	4	34	1	4	38
	16	21	5	26	----	10	36
	17	25	7	32	1	4	36
	18	11	5	16	----	2	18
	19	16	2	18	2	5	23
	20	13	6	19	1	2	21
	21	32	2	34	2	6	40
	Total	148	31	179	7	33	212
XIV	Jan. 22	13	2	15	2	2	17
	23	18	----	18	2	2	20
	24	15	3	18	2	----	18
	25	20	5	25	3	1	26
	26	18	6	24	1	7	31
	27	21	1	22	----	9	31
	28	9	2	11	1	7	18
	Total	114	19	133	11	28	161
XV	Jan. 29	12	----	12	----	1	13
	30	15	1	16	----	3	19
	31	26	2	28	----	1	29
XV	Feb. 1	3	1	4	----	3	7
	2	5	3	8	----	----	8
	3	9	----	9	----	4	13
	4	9	1	10	----	2	12
	Total	79	8	87	----	14	101
XVI	Feb. 5	12	5	17	----	----	17
	6	10	1	11	----	4	15
	7	12	----	12	1	----	12
	8	9	----	9	----	1	10
	9	18	4	22	----	5	27
	10	13	2	15	----	----	15
	11	4	3	7	1	4	11
	Total	78	15	93	2	14	107
XVII	Feb. 12	2	----	2	----	----	2
	13	3	2	5	1	----	5
	14	11	2	13	1	----	13
	15	5	----	5	1	4	9
	16	2	----	2	----	1	3
	17	2	1	3	----	1	4
	18	5	1	6	----	3	9
	Total	30	6	36	3	9	45
XVIII	Feb. 19	3	2	5	----	2	7
	20	4	1	5	----	2	7
	21	2	3	5	----	1	6
	22	3	----	3	----	2	5
	23	----	1	1	----	----	1
	24	4	1	5	----	----	5
	25	----	2	2	----	6	8
	Total	16	10	26	----	13	39
XIX	Feb. 26	1	1	2	----	----	2
	27	----	----	----	----	----	----
	28	----	1	1	----	----	1
	Mar. 1	3	----	3	----	1	4
	2	----	1	1	----	----	1
	3	----	----	----	----	----	----
	4	----	3	3	----	2	5
	Total	4	6	10	----	3	13

(Follows Plate IX.)

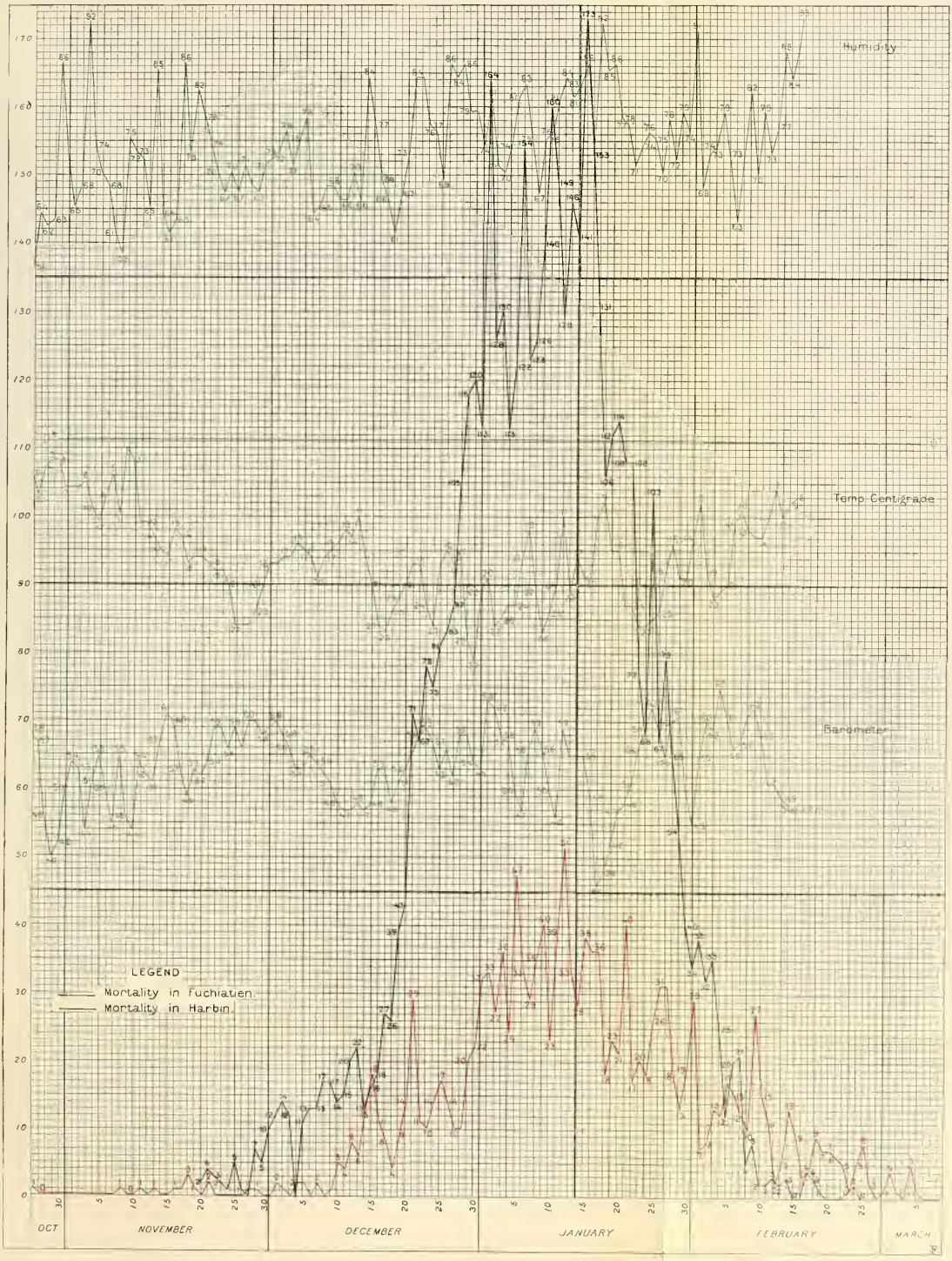

PLATE X. CURVES SHOWING RELATIONSHIP BETWEEN METEOROLOGICAL CONDITIONS AND THE MORTALITY IN HARBIN AND FUCHIATIEN.

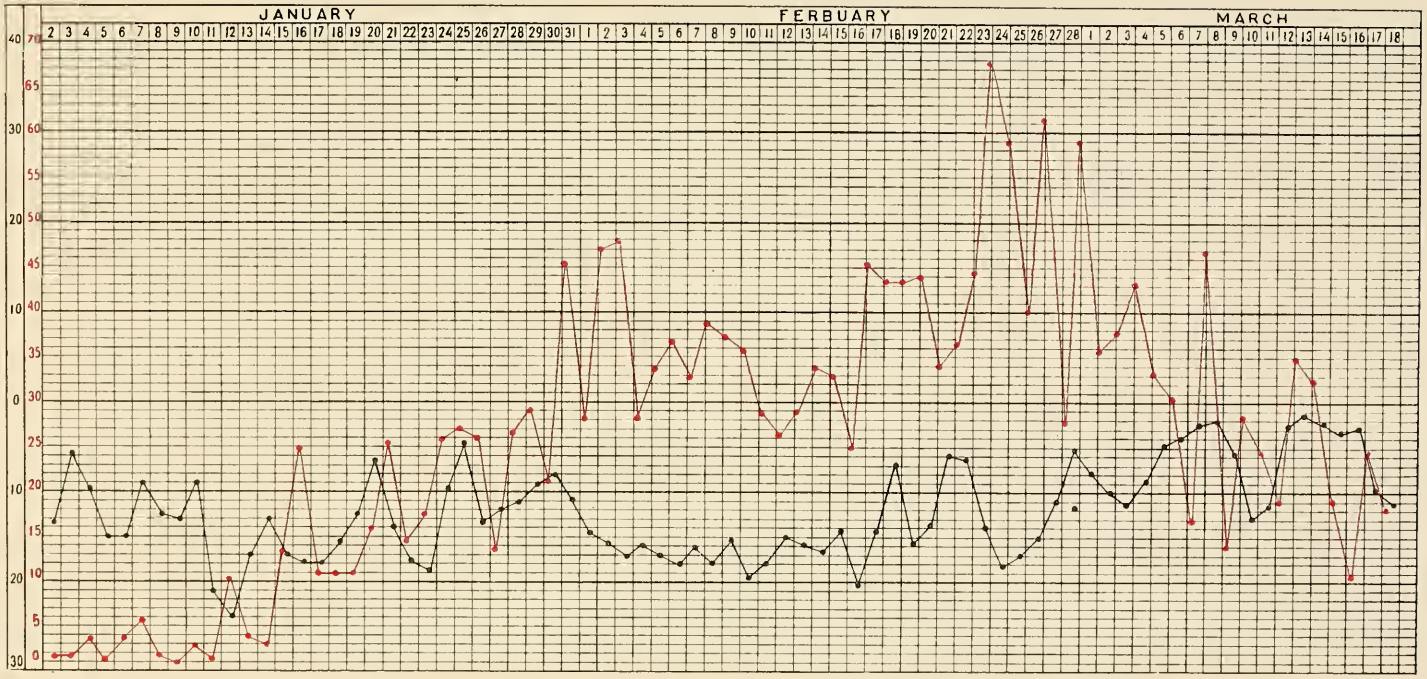

PLATE XI. CURVES REPRESENTING PLAGUE MORTALITY IN RELATION TO THE TEMPERATURE IN MUKDEN.

(Red curve, number of plague cases; black, temperature in degrees Fahrenheit.)

PLATE XII. CURVE REPRESENTING THE MORTALITY IN CHANGCHUN.

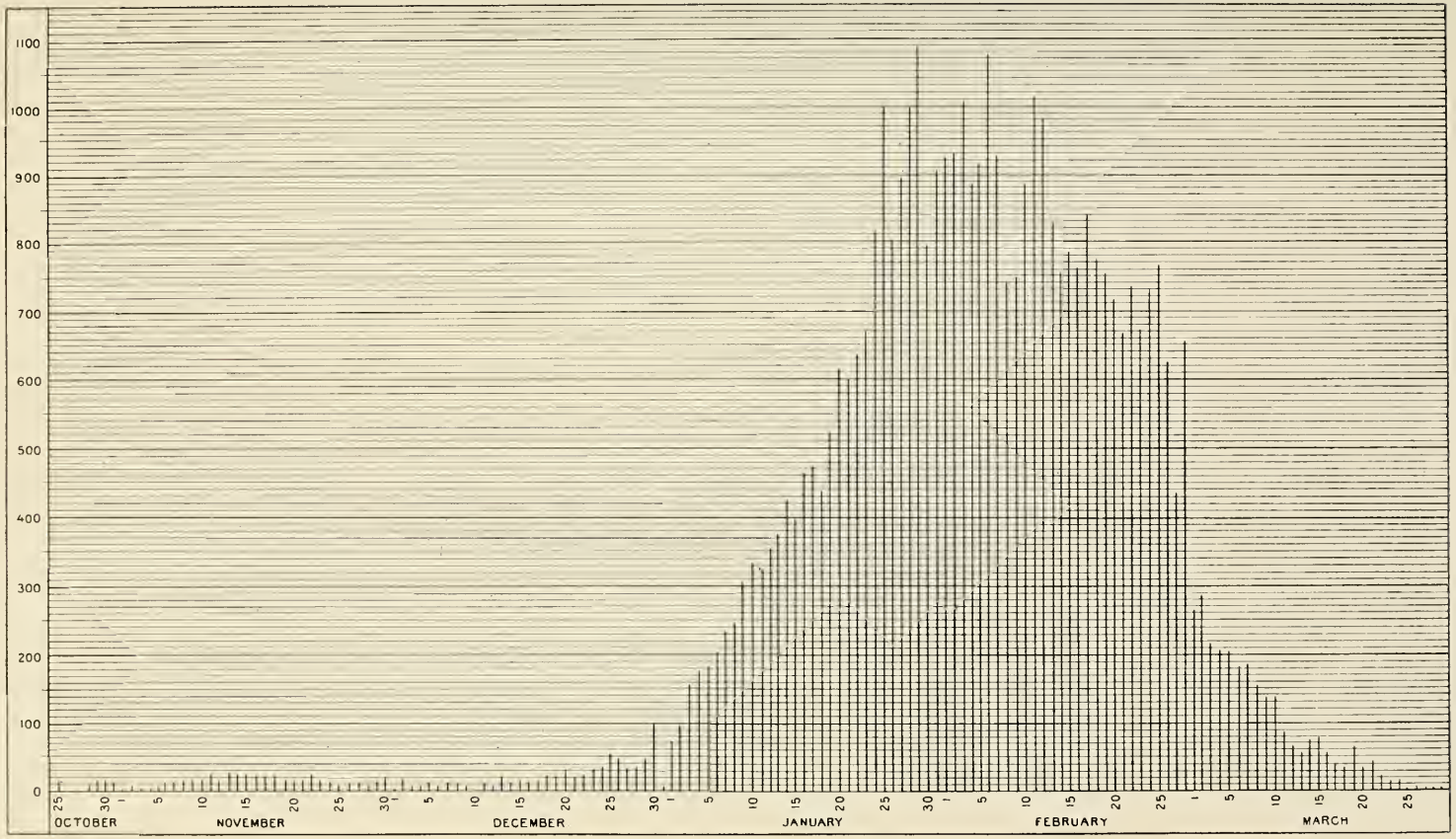

PLATE XIII. CHART SHOWING THE DEATH RATE FROM PLAGUE OCCURRING IN MANCHURIA DURING THE SIX MONTHS FROM OCTOBER 25, 1910, TO MARCH 29, 1911.

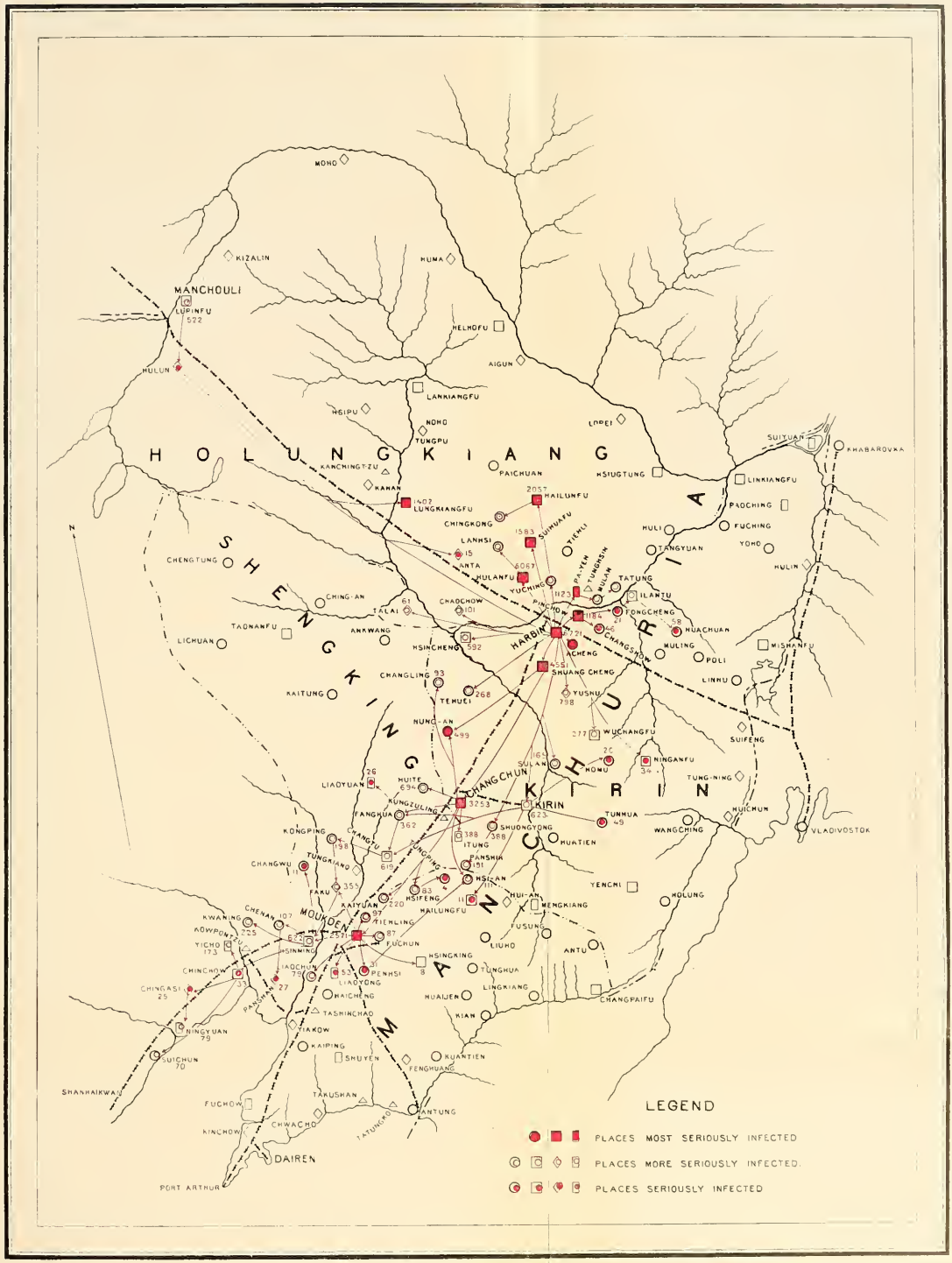

PLATE XIV. MAP SHOWING PLACES IN MANCHURIA SERIOUSLY INFECTED WITH PLAGUE DURING THE EPIDEMIC.

Table showing places infected, date of first appearance of disease, and number of deaths from plague in the three Manchurian provinces

Places infected.	Date of first appearance of disease.	Number of deaths.
HEILUNGKIANG.		
Lupinfu	Oct. 25, 1910	522
Hulun	Nov. 9, 1910	20
Lungkiangfu	Nov. 13, 1910	1,402
Hulanfu	Dec. 17, 1910	6,067
Suihua	Jan. 1, 1911	1,583
Hailun	Jan. 1, 1911	2,057
Lanhsi	Jan. 2, 1911	599
Mulan	Jan. 7, 1911	200
Payen	Jan. 16, 1911	1,123
Tatung	Jan. 18, 1911	92
Yuching	Jan. 20, 1911	618
Talai	Jan. 21, 1911	61
Chingkong	Jan. 24, 1911	176
Chaochow	Jan. 30, 1911	101
Anta	Feb. 10, 1911	15
Total		14,636
KIRIN.		
Harbin	Nov. 8, 1910	5,272
Harbin Railway line		1,449
Pinchow	Dec. 18, 1910	1,184
Tehuei	Dec. 22, 1910	268
Acheng	Dec. 23, 1910	1,794
Ninganfu	Jan. 1, 1911	34
Shuangcheng	Jan. 2, 1911	4,551
Nungan	Jan. 2, 1911	499
Changchun	Jan. '3, 1911	3,104
Changchun Railway line		149
Hsincheng	Jan. 5, 1911	592
Yushu	Jan. 5, 1911	798
Kirin	Jan. 18, 1911	623
Shuongyong	Jan. 19, 1911	388
Ilan	Jan. 20, 1911	164
Fongcheng	Jan. 21, 1911	21
Sulan	Jan. 22, 1911	165
Tunhua	Jan. 23, 1911	49
Itung	Jan. 30, 1911	388
Chauling	Jan. 31, 1911	98
Wuchang	Jan. 31, 1911	277
KIRIN—cont'd.		
Panshih	Feb. 5, 1911	198
Changchow	Feb. 12, 1911	46
Huachuang		58
Nomu	Feb. 14, 1911	20
Total		22,189
FENGTIEN.		
Mukden	Jan. 2, 1911	2,571
Tiehling	Jan. 10, 1911	97
Yicho	Jan. 13, 1911	173
Hsinmin	Jan. 14, 1911	622
Kwangning	Jan. 15, 1911	225
Chenau	Jan. 16, 1911	107
Changtu	Jan. 17, 1911	619
Suichun	Jan. 17, 1911	70
Faku	Jan. 18, 1911	355
Hsingking	Jan. 20, 1911	8
Fenghua	Jan. 22, 1911	362
Fushun	Jan. 22, 1911	87
Huaite	Jan. 23, 1911	674
Penhsi	Jan. 23, 1911	31
Kaiyuan	Jan. 26, 1911	220
Chingchow	Jan. 28, 1911	33
Kongping	Jan. 28, 1911	191
Chingasi	Jan. 29, 1911	25
Liaochung	Feb. 1, 1911	79
Ningyuan	Feb. 2, 1911	79
Liaoyuan	Feb. 3, 1911	26
Hsian	Feb. 4, 1911	111
Hsifeng	Feb. 5, 1911	93
Liaoyang	Feb. 6, 1911	53
Changwu	Feb. 17, 1911	11
Hailungfu	Feb. 18, 1911	11
Tungping	Feb. 23, 1911	4
Panshan	Feb. 24, 1911	27
Railway line		153
Total		7,117
Grand total		43,942

(Follows Plate XIV.)

As the total number of deaths varies somewhat in these different tables, the figures can only he regarded as approximate. These tables are also not entirely complete.—[EDITOR.]

Table showing the number of deaths from plague, per 1,000 inhabitants, in the three Manchurian provinces

Month.	Population of areas in which plague deaths occurred.	Number of deaths.	Death rate per 1,000.
October	7,453	64	8.5
November	148,522	452	3.0
December	788,831	724	0.9
January	9,960,996	13,666	1.4
February	13,242,079	24,147	1.8
March	12,294,705	2,780	0.2

Province.	Population.	Number of deaths.	Death rate per 1,000.
Heilungkiang	1,305,817	14,636	11
Kirin	4,642,917	22,189	5
Fengtien	7,369,773	7,117	1

(Follows Plate XIV.)

As the total number of deaths varies somewhat in these different tables, the figures can only be regarded as approximate. These tables are also not complete.—[EDITOR.]

PLATE XV. MAP SHOWING INFECTION OF CITIES BY MEANS OF THE RAILWAY, AND THE DIRECTION OF THE SPREAD OF THE EPIDEMIC.

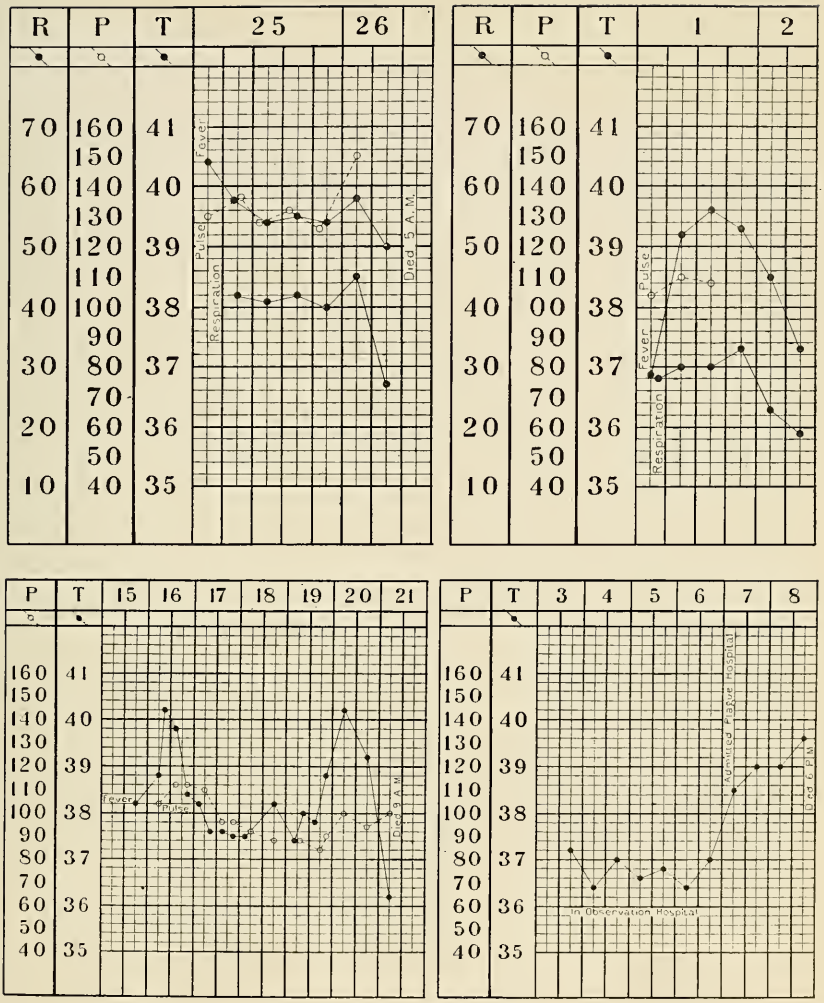

PLATE XVI. TEMPERATURE CHARTS IN PNEUMONIC PLAGUE.

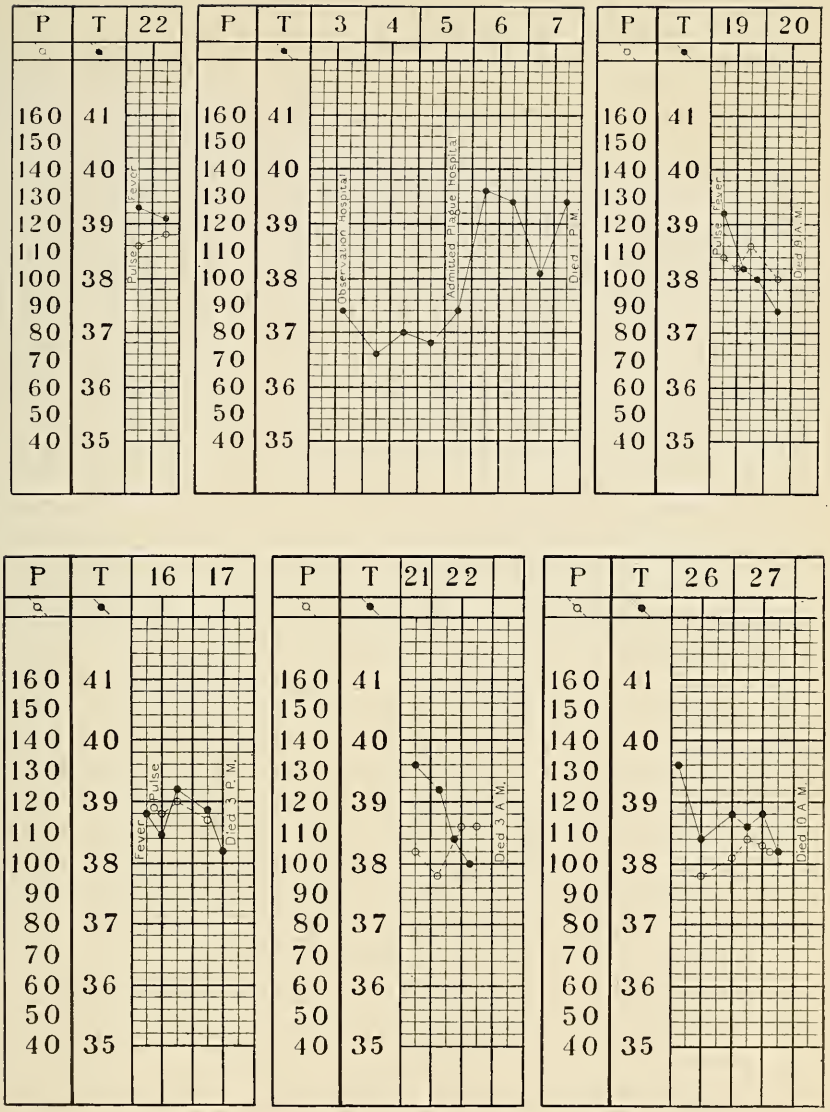

PLATE XVII. TEMPERATURE CHARTS IN PNEUMONIC PLAGUE.