The 1895 Epidemic Outbreak of Bubonic Plague in Macao

A Portuguese View on the Transmission and Spread of Plague

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Even though cities around the world harboured, and continue to harbour, millions of rats and perhaps billions of rat fleas, human plague outbreaks had multiple, and far from obvious, causes. This complex sequence is what triggered human plague epidemics, dependent on a wide range of variables involving, on the one hand, natural laws pertaining to climate, insects, and their rodent hosts and, on the other hand, elements of human agency such as international transport and trade and the housing conditions of the urban poor. Not until scientists and public health specialists understood these variables could they account for the seasonal and seemingly arbitrary pattern of plague diffusion around the globe
(M. Echenberg, *Plague Ports. The Global Urban Impact of Bubonic Plague, 1894-1901.* New York/London: New York University Press, 2007, p. 8).

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Antropóloga da saúde do IRD/Instituto de Pesquisa para o Desenvolvimento (França). Estudou xamanismo e saúde indígena na Amazónia brasileira durante vinte anos e publicou sobre xamanismo, saúde indígena, concepções indígenas das epidemias, mitologia, direitos indígenas, etc. Como membro da unidade de pesquisa UMR 190 'Patologias Virais Emergentes' (IRD-Universidade de Aix-Marseille II), actualmente, sediada na Mahidol University of Salaya (Tailandia), *faz investigação sobre epidemias e medicinas tradicionais no Sudeste Asiático As suas últimas publicações incluem um artigo sobre a concepção das doenças infecciosas na medicina chinesa (*Revue d'Anthropologie des Connaissances*, 1, 2010) e uma revista crítica dos dados sobrea epidemia de meningite cerebrospinal de 1932 em Macau (com Xavier de Lamballerie, in* Infection, Genetics and Evolution*, 10 (2010).*

INTRODUCTION

In 1895, when bubonic plague broke out in the Portuguese colony of Macao, one year after devastating Canton and Hong Kong, only the etiologic agent of the disease (the bacillus *Yersinia pestis*) was known. The role of the rat flea in the transmission and diffusion of the plague bacillus from rodents to rodents, rodents to humans and humans to humans was still unknown. It took some more years to be clearly defined. In this context, the report of Dr. Gomes da Silva, at that time chief of the health services of the Province of Macao and Timor, published in 1895 on the epidemic outbreak of bubonic plague is particularly interesting. In this report he readily integrated the knowledge of the plague bacillus into the current theories on bubonic plague and discussed with great clarity the question of infectiousness or contagiousness of the disease. The article examines the data on the epidemic outbreak that struck Macao in 1895. Following a description of the disease epidemiology, I review the data on the third pandemic of bubonic plague in China. Finally, I

examine the report published by Dr. Gomes da Silva on the epidemic outbreak of 1895, analysing in particular his theory of the dynamics of transmission and spread of the disease. Whilst numerous works have been published on the 1894 epidemic outbreak of bubonic plague in Hong Kong and Canton,[1] there are, to my knowledge, only passing references on the epidemic outbreak in Macao. This article is an attempt to fill this gap in Macao's history.

EPIDEMIOLOGY OF BUBONIC PLAGUE

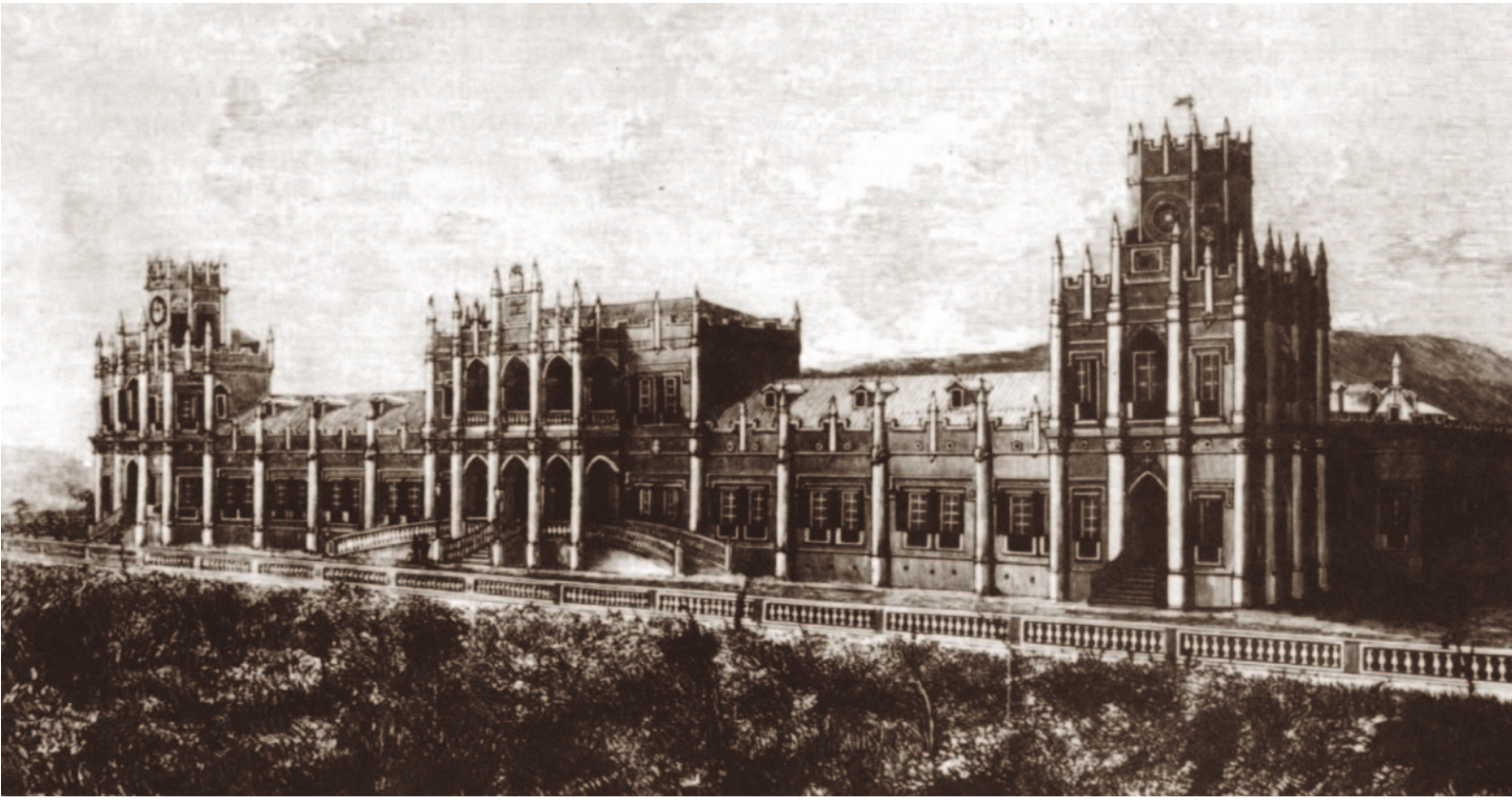
Bubonic plague is primarily a zoonosis, a disease of wildlife rodents and small mammals[2] and, incidentally, of humans. It is caused by *Yersinia pestis* (formerly known as *Pasteurella pestis*), a bacterial pathogen. This bacillus was isolated by the Swiss-born Pastorian Alexandre Yersin in the lymph nodes (or buboes) and blood of dead patients during the Hong Kong epidemic outbreak of 1894.[3] It ordinarily parasites small wild rodents without major damage, being transmitted from one to another through the bite of their flea ectoparasites.[4] Due to some ecological change or disturbance, some highly susceptible rodents such as the domestic black rat (*Rattus rattus*) or the brown rat (*Rattus norvegicus*) may come in contact with the plague bacillus through the bites of flea ectoparasites. Once infected, they develop an overwhelming infection ending with rapid death. Their fleas then leave the dead body, looking for other warm-blooded hosts (a rat or a human) to feed on, transmitting in this way the bacillus through their bites. Black rats are very susceptible to plague infection. Once infected, they die in great numbers. As they live in close proximity to humans and their dwellings, they are the main source of human infection in urban settings. An epizootic followed by a great mortality among the population of rats usually precedes and/or accompanies the appearance of human cases of plague. The brown rat, which lives in dark cellars and sewers, has less contact with humans. It is a secondary source of human infection.[5]

The plague bacilli do not spread directly from person to person. They are transmitted by the bites of infected fleas, the Oriental rat flea *Xenopsylla cheopi* being the most efficient vector. The so-called human flea *Pulex irritans*, which feeds on humans and other animals (wild foxes, badgers, ground squirrels, guinea pigs, rats, domestic pigs, dogs, cats, etc.) and is found in human dwellings, may also transmit the plague bacillus.[6] It is, however, a less efficient vector. The role of the rat flea in the transmission of the plague bacillus was highlighted by the French Pastorian Paul-Louis Simond during the 1898 epidemic outbreak in Bombay.[7] However, his hypothesis of a link between plague, rats, fleas and humans was only accepted by the medical community in the early 20th century.[8]

As stated in the citation above, rats and their infected fleas are only part of the problem. In urban settings, plague epidemic outbreaks are usually restricted to locals infested by rats and their fleas. In the past, the risk of contracting the infection was very high for people of low classes because of their bad living conditions: overcrowding, unsanitary dwellings, and houses infested by rats. Climatic conditions have an impact on the epidemiology of bubonic plague, the majority of epidemics occurring during seasons in which temperature and atmospheric humidity are moderately high. According to Twigg, for instance, a temperature between 18.3ºC and 29.4ºC and a humidity of 70% are optimum conditions for the survival of rat fleas. Extreme temperatures, heavy rains or dry weather kill the infected fleas. In temperate countries, epidemic outbreaks usually occur in spring and summer, whereas in tropical countries they break out in late winter or early spring.[9]

When a person is infected, the bacilli invade the lymphatic system. After an incubation period of 3-10 days, infected persons present a kind of severe influenza with high fever, chills, headache, pain in the chest, coughing, weakness, extreme fatigue, vomiting and nausea, etc. Plague infection may manifest in three forms, bubonic, septicaemic or pneumonic. In bubonic plague, the most common form of the disease, the patient develops a dark carbuncle on the flea bite site. A few days later, the bacilli spread to the lymph nodes (in the neck, under the arms, in the groin) close to the flea bite. Due to an inflammatory process, these turn into hard and painful swellings or buboes of the size of an egg (4-5 centimeters). Buboes are the most characteristic sign of the disease. In some cases, generally at the height of the disease, the bacillus reaches the bloodstream, causing a septicaemia that kills the victim in a few hours or days, representing the septicaemic form of the disease.[10]

Buboes are not always present. Because of their absence and/or the similarity of the initial symptoms



S. Januário Hospital, c. 1880, from R. Beltrão Coelho, *Álbum Macau 1844-1974*. Macao: Fundação Oriente, 1990.

of bubonic plague with those of other infectious diseases (such as, for example, typhus fever, typhoid fever, malaria, tularemia, diphtheria, etc.), a differential diagnosis is not always easy to establish. Examples of the difficulty to properly diagnose bubonic plague at its onset abound in historical sources. In South China, for example, the disease is said to 'begin invariably with a fever of a typhoid character'.[11] In 1894 in Canton, the first recorded case of plague was diagnosed as typhus fever by the missionary physician Mary Niles, whereas the first cases of bubonic plague in Bombay in 1896 were mistaken for diphtheria and fever.[12] Even at the onset of the 20th century, the diagnosis of bubonic plague was difficult to establish, particularly in the absence of buboes or of a rat epizootic preceding and/or accompanying the emergence of human cases.

As said above, transmission and propagation of bubonic plague in a human population depend on the presence of infected rat fleas. It means that the bacillus that causes the disease cannot be transmitted directly from one person to another. In some cases, however, a plague-stricken patient develops a secondary pneumonia. This is the pneumonic plague. Characterised by a brutal onset with pains in the chest and violent coughing with expulsion of bloody sputum, it is transmitted directly, via the inhalation of respiratory droplets. This form of plague is highly contagious and, before the use of antibiotics, mortality rates were close to 100%.[13]

The severity of bubonic plague varies according to the epidemic or to the different stages of an epidemic. Before the advent of serotherapy and antibiotics (streptomycin, tetracycline, and sulfonamides), mortality rates varied between 30% to 100% of the disease cases.[14]

THE THIRD PANDEMIC OF BUBONIC PLAGUE

Epidemic and pandemic outbreaks of bubonic plague have occurred in the past, killing millions of people around the world. Unlike the two first

pandemics known under the names of the 'Justinian Death' (6th century) and the 'Black Death' (mid-14th century) which broke out, respectively, in the Mediterranean area and in the Caspian region, the third one initiated in the Province of Yunnan, southwestern China. It was said to be endemic there since the late 18th century, having been imported through trading routes from Burma or, according to other sources, from Tibet.[15] During the Mohammedan Rebellion against the Imperial government (1855-1873), a violent epidemic outbreak of bubonic plague swept through Yunnan province, decimating the local population. The Frenchman Émile Rocher, who travelled in the province during the years 1871-1873 as a member of the Chinese Imperial Customs Service, testified to its devastation through the combined effects of the civil war, the famine and the virulent epidemic outbreak.[16] Troop movements from the war favoured the spread of plague to the neighbouring provinces of Guangxi and Guangdong: the disease was thus registered in Pakhoi, southwestern Guangxi, in 1867. In March 1894, some 27 years later, it was reported in Canton, capital of Guangdong province. From Canton, it made its way to the British treaty port of Hong Kong, some 80 miles distant, through close communication by junks and river boats, where it broke out in May of the same year. Strangely, it did not reach the Portuguese colony of Macao despite its daily communications with both cities.

From Hong Kong, the disease reached the major port cities around the world in a few years, carried by rats and their infected fleas through steamships. It was, for example, registered in Singapore, Bombay (India), and Formosa (Taiwan) in 1896; in Kobe (Japan) in 1898; in Alexandria (Egypt) and Porto (Portugal) in 1899; in Buenos Aires and Rio de Janeiro (respectively, Argentina and Brazil) in 1899/1900; in Manila (Philippines) in 1900; in Mexico City (Mexico) in 1902; in Lima (Peru) in 1903; and in Ghana (then Gold Coast, Africa) in 1908.

In the late 19th and early 20th century, bubonic plague was a major public health problem in South China and South-East Asia. Recurring epidemics have been registered, for example, in Hong Kong (1896, 1898, 1899, 1902, 1914), Canton (1895, 1896, 1898), Pakhoi (1877, 1882), Macao (1896, 1897, 1905, 1906, 1907, 1908, 1909), Indochina (1907, 1908, 1909, 1911, 1913), Bombay, India (1896, 1898), etc.[17] These epidemic outbreaks varied in intensity and severity according to the cases, the locality or region. In India, for example, bubonic plague caused the death of 6,000,000 persons during the period 1898-1906.[18] In 1903, it claimed the life of five thousand people in only one day.[19] In Canton, the 1894 epidemic outbreak killed from 60,000 to 100,000 persons in a population estimated to be two million peoples.[20] Although it caused great alarm and panic among the local population of Hong Kong, it was responsible for the death of less than 2,500 people.[21] Needless to say, these numbers are probably underestimated given the absence of an official system of death notification and of the Chinese reactions (flight from the infected area, rejection of western medicine, etc.) to the epidemic disease. Interestingly, the epidemics of bubonic plague seemed to be always relatively mild in Macao. For example, the epidemic of 1895 caused the death of 1,063 persons. The outbreaks of 1904, 1905, and 1907, claimed respectively, the life of 205, 186, and 1,043 persons. In 1909, only 45 persons died from the disease[22]:

> Whereas this disease prevails in these regions [Canton and Hong Kong] in endemic and epidemic forms, indiscriminately attacking indigenous [Chinese] and European peoples, it rarely acquires here [Macao] an epidemic character; in certain years, it even doesn't appear as, for example, in 1908 when no case of the disease was registered...; moreover, only exceptionally it attacks the European[23] (my translation).

At that time, the relative mildness of bubonic plague in Macao was attributed to the salubrious climate of the city.[24] After the discovery of the etiologic agent and of the role of rat fleas in the transmission of the disease (late 19th to early 20th-century), it was ascribed to different factors, including: the salubrious climate which furnishes improper conditions for the habitat and development of the vector of the bacillus (the rat flea); the absence of the domestic black rat *Rattus rattus* which is the main known reservoir of the bacillus; the scarcity of other species of domestic rats due to their annihilation by the brown rat (*R. norvegicus*) or by the cats which live in great numbers in the colony; and, finally, the rarity of the human flea (*Pullex irritans*), another vector of the plague bacillus, although less efficient than the rat flea. The brown

rat, which is the main species of rat found in Macao, lives mainly in sewer areas, which is why in Macao the disease is mainly circumscribed in those areas.[25]

The third plague pandemic ended in the late 1950s. According to some estimates, it killed approximately fifteen million people, the greater numbers living in India, China and Indonesia.[26] Following its recent resurgence in different regions around the world, however, it has been classified as a re-emerging disease.[27]

THE EPIDEMIC OUTBREAK OF BUBONIC PLAGUE IN MACAO

As said above, the epidemic of bubonic plague that raged in Canton and Hong Kong in 1894 did not reach Macao, despite the close contacts of the Portuguese colony with both cities. It appeared only in March of the following year. This apparent immunity in relation to the disease was attributed by the majority of the population of Macao to the hygienic conditions of the city, but for Dr. da Silva it was, above all, due to the public health measures he quickly implemented when he heard about the epidemic disease that was raging in Canton and Hong Kong.[28] Actually, at the end of March, 1894, Dr. da Silva received notice from the Portuguese Consulate at Canton of the existence of a 'very curious' disease presenting with high fever and buboes in the neck, armpit and inguinal region, and which for a month had been affecting 'the Chinese … and the rats'. Shortly after, rumours about the presence in Hong Kong of a virulent epidemic of 'a species of typhoid fever' began to circulate in Macao.[29] Later information received from Canton said:

> With regard to the species of disease, it is considered to be the plague, of the same nature as the one which broke out in London in 1665; though with the difference that whereas it was there an extraordinary epidemic, it [usually] manifests under an endemic and not very intense form in the East[30] (my translation).

In view of this information, Dr. da Silva quickly took some preventive measures to protect Macao from the invasion of bubonic plague. In order to avoid the opposition of the Chinese population of Macao, whose rejection of western medicine was well known, and also not to hurt the susceptibility of the neighbouring colonies, these measures were taken silently, i.e., without the apparatus of a provincial decree. They were the following: to prohibit the agglomeration of peoples in houses, *a fortiori* when they did not observe rules of basic hygiene; to close the wells having probable or potential communication with public latrines and other sources of infection; to irrigate frequently the sewers of public ways with chlorinated seawater; to supply the population of Macao with drinking water because of the closure of suspected wells and of the severe drought which had been afflicting, since the month of September 1893, all the littoral region of Southern China; to examine the passengers of boats arriving from Hong Kong and Canton in order to detect persons presenting with fever; to visit every day the Keng-Wu Chinese hospital in order to get information about the diseases treated; and, finally, to inspect and eventually close public latrines.[31]

On 10 May, 1894, when the British port of Hong Kong was finally declared infected, Dr. da Silva published in the *Boletim Official* of the Province of Macao and Timor two provincial decrees (nos. 113 of 15 May, and 117 of 1 June, 1894) determining the public health measures which would be applied in order to prevent the invasion of bubonic plague in Macao. These were mainly the preventive measures he had implemented before to receive the official confirmation of the nature of the epidemic disease that was raging in Canton and Hong Kong. In addition, the provincial decree no. 117 determined the creation of a sanitary cordon aiming to control the access of Macao by land. The entry in Macao was thus only permitted in three points where there was a western physician: *Portas do Cerco*, *Praia Grande* and the pier of *Matapau*.[32] Although the content of some of these preventive measures might sound strange in the context of the current knowledge of the epidemiology of bubonic plague, they nevertheless gain their meaning and importance from various facts. Firstly, it seems that western observers at different periods and in different localities had observed that when spring rains arrived early and were abundant, bubonic plague seldom appeared in a locality. In Canton, a city of two million inhabitants, devoid of sewers in public ways, where household refuse was abandoned into the streets and left accumulating and putrefying under the sun, the cleanliness of the city was strictly dependent on the annual river overflow induced by the torrential spring rains.[33] However, bubonic plague broke out in Canton

and Hong Kong after an exceptionally severe and prolonged period of drought that afflicted all the littoral region of South China.

> Is it possible to think that during the dry season Chinese people are only supplied by water from quasi-exhausted wells which is hence more concentrated in putrid and bacteriological matters, as seems to be the case of water sources and wells in Chinese communities? Is it possible to think that torrential rains, which clean the streets and drag out the household refuse, are crucial to the healthiness of a Chinese locality which, from the capital of the Empire to the common village, has the cult of the refuse?[34] (my translation).

Both possibilities—which might be true—were thus at the basis of three of the preventive measures adopted, including the irrigation of sewers with chlorinated water, the supply of populations with drinking water, and the cleaning or closure of suspected wells.[35] Other measures included: the destruction of the *Sakom* village, the embankment of the area and the tracing of the streets for the new village; the exhumation from the old cemetery and the transfer outside of Macao of the mortal remains;[36] and, above all, the demolition of the *Horta do Volom* (district of *Volom*) which, according to Dr. da Silva, was the equivalent of the Tai Ping Shan district of Hong Kong where the disease initiated and raged with great virulence in 1894. Mainly constituting slums of wood or brick, its canalisations were reduced to some 'uncovered drains always full of a putrid and dark liquid'.[37] Its destruction was thus essential to the healthiness of Macao:

> It cannot be said that, even with the existence of the [district of] *Volom*, we did not receive the visit of bubonic plague this year; the disease never appeared before in Hong Kong despite the existence half a century ago of the district of *Taipinxan* [*Tai Ping Shan*]. The favourable soil exists; what was lacking was the seed which only this year came to Hong Kong and which unfortunately may come to Macao next year... If the telluric and atmospheric environments are unfavourable to the development of the germs of plague, the disease will not manifest. There is no other way to explain the disappearance of this epidemic disease in Europe or the relative immunity of Shameen [foreigners' settlement in Canton] and the absolute immunity of Macao [to the disease]. The district of *Volom*, a very precious environment for the culture of the bacillus of Kitasato,[38] was at the heart of the city, defended by a sanitary cordon and by the medical inspections; the seed of the epidemic disease cannot arrive in Macao. The situation can be the same next year, even with the existence of the district… [However] it is certain that in absence of a favourable terrain, the seed, even present, will not germinate…[39] (my translation).

Although required for a long time by the successive chiefs of the health services of Macao,[40] the destruction of this very unsanitary Chinese district of Macao had not been realised before for lack of resources. Facing the danger of the invasion of bubonic plague, it was finally approved by the governor of Macao and the necessary resources were allocated to the project.

Unfortunately, even with the demolition of the *Horta do Volom*, bubonic plague entered Macao a year later. It recurred again in 1897, 1898, and many times during the early 20th century. The first case of bubonic plague was registered on 24 March 1895; a Chinese man arriving from Hong Kong. Shortly after, a second case was reported, ending, as did the first one, in rapid death. Many control measures were soon taken by the physician in charge of the health services during the absence of Dr. da Silva, who was at that time in Portugal. It was decided that Chinese and European patients would be isolated in the barrack-hospital of *Solidão*. Constructed on the area of the old lazaretto built during the 1888 epidemic of cholera in Macao, this barrack-hospital opened its doors on 10 May. It consisted of four barracks for plague patients and two for suspected cases. However, as Chinese patients were strongly adverse to western medical treatment, the barrack-hospital of *Solidão* was finally destined for the isolation and treatment of the catholic population of Macao, Chinese or not Chinese, who accepted to be treated according to the precepts of western medicine. The majority of patients treated there had been denounced by the sanitary police or by neighbours and forced to accept the hospitalisation. In all, the barrack-hospital of *Solidão* received 21 plague patients, 16 of whom died (a mortality rate of 63.6%). The last plague patient entered on 30 June. In July, after the transfer of the last patient to the

Keng-Wu hospital, the barrack-hospital of *Solidão* was destroyed by fire.[41]

Two barrack-infirmaries were also installed in the Chinese hospital Keng-Wu, one for the isolation of Chinese plague-stricken patients who refused to be treated by western physicians, the second one for suspected cases. Each case of death in the Chinese hospital was checked by a Portuguese physician; otherwise, the burial was not permitted. The ground floor of infected houses was disinfected with lime chloride and fumigations of tar and sulphur. The sewers in public ways were regularly cleaned. Posts for disinfection, with permanent bonfires put at the front, were set up in various points of the city. All boats and other embarkations arriving from Canton were inspected by a physician in search of suspected cases of the disease because Canton had been declared as infected. Finally, a member of the health services supervised the services of hygiene and sanitation of Macao and a medical post destined to send plague-stricken patients to the respective hospitals and to check the number of deaths due to the disease was established in the building of the municipal council. For lack of personnel, however, it was not possible to install a sanitary cordon to control the access by land of Macao.[42]

Actually, these measures were problematic for a number of reasons: firstly, the sanitary inspections concerned only boats and other embarkations arriving from Canton because there was no information about possible cases of bubonic plague in Hong Kong.[43] Secondly, for lack of time, personnel and resources, the measures of disinfection concerned only the houses of plague-stricken patients. Thirdly, death cases among the Chinese population were not systematically checked by a member of the health services.[44] In any case, despite the measures adopted, bubonic plague continued to spread in Macao. In late April and early May, the daily mortality from the disease was oscillating between 23 to 28 persons. As in Canton in 1894, the European district of Macao was spared by the disease.[45]

Panorama of Macao, c. 1905. From R. Beltrão Coelho, *Álbum Macau 1844-1974*. Macao: Fundação Oriente, 1990.

On 14 May, when Dr. da Silva finally arrived in Macao, the epidemic was at its height. He was touched by the very desolate aspect of the city:

> The transport of the coffins throughout the streets at each hour; the posts for disinfection with the permanent bonfires put at the front; the closed doors of a great number of Chinese buildings and shops not only in [the district of] *Bazar* but also in the main streets of the city (*Rua Central*, *Rua de S. Domingos*); the terror manifested by the population; all these circumstances were giving a desolate and gloomy aspect to the city which, although not comparable to the one observed in Hong Kong during the epidemic outbreak of the previous year, adopted nevertheless the particular character of those great calamities that sometimes ravage the densely populated centers deprived of hygiene[46] (my translation).

Not much action could be taken at this stage, with the exception, perhaps, of the removal of plague-stricken patients outside of Macao. This could limit the expansion of the disease and put an end to the desolating aspect of the city. Actually,

> Every plague-stricken patient removed was an epidemic center eliminated from the city. The patient was taking away the pus of buboes and the infectious diarrohea; when dead, he will not increase the files of coffins which were going through the streets and roads of Macao to the *Portas do Cêrco*…[47] (my translation)

Indeed, due to the great diffusion of the disease in the city, the absence of removal from Macao of plague-stricken patients was rendering ineffective the measures of disinfection and sanitation implemented. Although it rarely recurred again in a once-infected house, plague was nevertheless returning to the district, attacking other houses with a 'capricious irregularity'.[48] In view of this fact, the construction of a new barrack-hospital for the isolation of plague patients outside of Macao was decided. The barrack-hospital of Lapa[49] was built on the Island of Lapa, in an area well-ventilated and with much sunlight. It opened on 28 May and the transfer from the Keng-Wu hospital of plague patients soon began. Some modifications were introduced at the same time in the service of hygiene and sanitation of the city. The bonfires at the entrance of the posts for disinfection were extinguished; the fumigations of tar and sulphur, which were consuming the atmospheric oxygen and indisposing the neighbouring houses, were substituted by local disinfections with lime chloride and ferrous sulphate mixed with phenic acid; the sewers were cleaned with seawater and bluestone; some public latrines, perceived as true sources of bacteria, were closed; several public wells were blocked up whereas others were cleaned and various sewers were consolidated, etc.[50] Thanks to the foundation of the barrack-hospital of Lapa and the removal of the plague-stricken patients, mortality due to bubonic plague started to diminish. The epidemic outbreak began to recede at the end of May, being considered extinct in July. In all, it lasted three months, from the end of March to the beginning of July, killing a total of 1,063 persons. Needless to say, the situation could have been worse given the existence of the very unsanitary district *Horta do Volom*.[51]

Treatment of plague-stricken patients was purely symptomatic: digitalis, bromide of potassium, quinine, antifebrin, strychnine, arsenic, and other drugs were alternatively used to combat the high fever and regulate the pulse, but without success. Cold or slightly warm baths were also used but with no success. As pointed out by Dr. da Silva,

> Treatment of bubonic plague… by western physicians has always been symptomatic. If the internal and external environments[52] of the patient allow his organism to react against the immediate effects of the blood poisoning and to wait for the elimination of the bacteria and toxins of the plague, the patient will survive; in the opposite case, he will die even if the symptomatic treatment is rational or absurd, or prescribed by the intelligent hand of the western physician or administered by the unconscious hand of the native healer[53] (my translation).

As the laboratory experiments of Kitasato seemed to prove the elimination of the plague bacillus with a solution of phenic acid at 5%, Dr. da Silva tried to introduce in one day 0.50 centigrams to 3 grams of phenic acid in the organism of four patients. On the four patients treated in this way, two had a fatal outcome and two improved. As concluded by the Portuguese physician: '*Mais vale evital-a que remedial-a*' (It is better to avoid it [the disease] than to apply remedies). And it was relatively easy to avoid it: 'Every person just need to be convinced of the utility of hygiene and its unquestionable supremacy on therapeutics'.[54]

A PORTUGUESE VIEW ON THE TRANSMISSION AND SPREAD OF BUBONIC PLAGUE

At the time of the epidemic outbreak in Macao, western medicine had made significant progress in the understanding of the etiology of bubonic plague. In 1894, Yersin isolated the etiologic agent of the disease (the plague bacillus *Yersinia pestis*), showed that the same bacillus was causing the disease among humans and rats and, finally, proved the soil infection by the bacillus which he encountered at a depth of 4-5 cm in the soil of infected houses.[55] However, he did not explain the precise means by which the plague bacillus was transmitted and spread from rat to rat, rat to human and human to human. The hypothesis of a link between plague, humans, rats and their fleas was highlighted by Paul-Louis Simond in 1898, during the epidemic outbreak in Bombay. However, this hypothesis was initially rejected by western physicians working abroad. It was only in the early 20th century, when repeated laboratory experiments have demonstrated this link, that western physicians were finally convinced of the rat flea-human transmission. Thus, at the time of the epidemic outbreak in Macao, conflicting opinions about the spread of the plague bacillus were prevailing: transmission through food, through the inhalation of a noxious vapour arising from the ground, through the clothes and other personal belongings of plague patients, and/or through open sores, etc. As synthesised by Simond:

> The virus [i.e., the plague bacillus] emitted with the excrement of patients, humans and rats, once widespread on the soil and mixed with dust, entered by different means the skin and mucous membranes and reached the human organism through food [an intestinal form of the disease was hence admitted], through the air inhaled or through open sores. The high incidence of indigenous cases of the disease [in India] was, for example, attributed to the Hindu habit of walking without shoes which favoured the penetration of the virus through the numerous open sores on their weakened limbs[56] (my translation).

In his report on the epidemic outbreak of bubonic plague, Dr. da Silva made important observations on the factors of different orders that may have favoured the occurrence and spread of the disease among the population of Macao in 1895. He noted its capricious course: it neither affected indistinctively persons or districts nor raged everywhere with the same virulence. He defined bubonic plague as an infectious disease, endemic in the East, communicable but not contagious. Actually, its capricious course and the fact that no patient hospitalised in the barrack-hospital of Lapa with plague-stricken patients caught the disease were strong arguments against the supposed contagiousness of bubonic plague. Like cholera or typhoid fever, it belongs to the group of the '*[doenças] infecciosas puras*' (true infectious diseases), sub-group of zymotic diseases (i.e., caused by a virus or other infectious agent acting on the organism like a ferment). However, its diffusive power is inferior to that of cholera. Communicable infectious diseases are due:

> to the presence of bacilli originating or developing in the blood of an individual, the power of diffusion of which is eminently favoured by the accumulation of individuals, the lack of prophylaxis, and by the complex action of the internal and external environment which generates immunities and predisposes individuals [to the disease]. When a disease of this group rages in a community, the drinking water or the air inhaled are full of bacilli originating from the patient who thus can transmit the disease, albeit only in an indirect way, to a healthy person when she drinks the infected water or inhales the infected air. If it is true that, in every epidemic, immunities [to the disease] manifest themselves in individuals living in direct contact with infected persons, it is not less true that severe forms of these diseases only appear in conditions of the internal and external environment which are specific to each morbid entity. Thus, a simple diarrhoea, which has no special signification or which can be perceived as favourable to a healthy individual during an epidemic outbreak of plague, will turn itself into a serious predisposition for the installation of the choleric bacillus during an epidemic of cholera. Whereas plague and yellow fever seem to appear preferably in hot and humid climates, influenza is more lethal during winter in temperate climates. If the influence of the environment is incontestable, the conditions of this influence are nevertheless specific to each epidemic disease…[57] (my translation)

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In the case of bubonic plague, the main vector of the plague bacillus is, according to Dr. da Silva, the inhaled air, the infective power of food, water or soil being not yet proved. However, it is important to stress that contact with a plague patient will never be sufficient to promote the infection.[58] Actually, the transmission, development and spread of the disease are favoured by conditions of the environment, internal and external. The expression 'internal environment' mainly refers to the individual temperament and constitution. In 1895, and again in 1897, the disease attacked almost exclusively the Chinese people where the 'lymphatic temperament' is the norm. *Macaense* people with a lymphatic temperament were also affected by the disease. Whilst Portuguese and other European peoples, who are characterised by a sanguineous, nervous or mixed temperament, were totally immune to the disease, *Macaense* people bearing the same temperament, if not immune to the disease, were at least resistant to the severe forms of bubonic plague. Moreover, only people with an impoverished constitution due to ethnic heredity or to a deficient

The Inner Harbour, Macao, c. 1900. From Cecília Jorge and Beltrão Coelho, *Álbum Macau. Sítios, Gentes e Vivências*. Macao: Livros do Oriente, 1990.

alimentation have been afflicted by the disease.[59] Hence, a lymphatic temperament and an impoverished constitution are predisposing factors for the disease. Other factors such as occupation, use of alcoholic beverages and/or opium appeared to have no impact on the infection and its development. Although the majority of plague patients were found among native coolies and porters, this apparent preference for an occupation must be attributed to the contrast between a heavy work and a deficient alimentation. Finally, age and sex have no impact on the infection and its development: Actually, the 1895 epidemic outbreak of bubonic plague in Macao killed 380 men, 382 women and 301 children.[60]

Factors linked to the 'external environment' are multiple and diverse, being linked for the most part to the conditions of sanitation and hygiene of houses and streets, including overcrowding, darkness, humidity and bad ventilation of houses and rooms and accumulation of filth in the houses and in the streets. In the view of Dr. da Silva, for example, the accumulation of decomposing household refuse in the streets, due to the absence of the torrential spring rains and of the consequent overflow of the Pearl River which annually cleans the city, greatly favoured the spread of the disease in Canton in 1894. Moreover, he attributed the severity of the epidemic outbreak in Hong Kong to the measures adopted by the British with regard to the refuse. According to the Portuguese physician, in their attempts to clean the city during the epidemic outbreak, the British turned over too much the refuse accumulated by the native population in the streets during half a century. That is why when bubonic plague broke out in Macao in 1895 he ordered the refuse to be left untouched in the streets which was then only disinfected.[61] Moreover, the role of sunlight and fresh air as important hygienic elements for human dwellings and streets cannot be dismissed. Actually, overcrowding, accumulation of filth in the houses and in the streets and above all absence of sunlight and fresh air were seen as breeding grounds for the development of bubonic plague. This may explain why some very unsanitary Chinese districts where household refuse was accumulating, such as the *Horta de S. Paulo*, for example, were almost exempt from the epidemic disease whilst more healthy districts, such as the *Praia Manduco*, for instance, were seriously affected by it.

> In the *Horta de S. Paulo* there was household refuse [everywhere] with all that this means but there was also much sunlight and fresh air; because the area, localised on a hill slope, receives the sunlight and the winds and [the refuse] is carried out through the torrential rains; on the other hand, in the *Praia Manduco*, a low district spared from the winds, composed of dark, sunless and poorly ventilated dark dead-end streets, some of them without any exit, the plague bacillus encountered conditions favourable to its development, perhaps more slowly but, because of this, with more prejudicial effects[62] (my translation).

Other factors linked to the external environment include, according to Dr. da Silva, the climate and the seasons. If the climate seems to have a debatable role on the epidemiology of bubonic plague (epidemics appear in temperate and tropical countries), the same cannot be said of the seasons. The epidemic outbreak of 1895 broke out in early spring when temperature and humidity were moderately high and receded in June, during the summer.[63] According to a diagram annexed to the report of Dr. da Silva,[64] temperature oscillated between 15°C and 30°C and humidity between 75.6% to 91.0% during the epidemic period. Subsequent epidemics in Macao also occurred in late winter or early spring and receded in summer. Although Dr. da Silva offered no explanation for this apparent seasonal prevalence of plague, medical observers and physicians had since long time hypothesised the existence of an antagonism between an extreme hot temperature and the development of the disease.[65] Actually, the seasonal occurrence of plague was attributed later to the ecological characteristics of rat fleas.

CONCLUSIONS

Although still ignoring the pathogenesis and epidemiology of bubonic plague and, in particular, the vector role of the rat flea, Dr. da Silva made interesting observations on the occurrence, spread and extinction of this disease in Macao. Unlike some of his contemporaries who persisted in perceiving bubonic plague as a contagious filth disease spread by direct contact between peoples or through their clothes and other personal belongings, or who attributed it to the inhalation of a miasma arising from the ground, Dr.

da Silva tried to link the recently acquired knowledge of the plague bacillus to individual, social and environmental conditions. As it happened to be known, poor sanitation and hygiene, overcrowding, lack of sunlight and bad ventilation of houses and streets as well as a high number of rodents are conditions that enhance plague transmission in an urban context. Even if some conclusions of Dr. da Silva are wrong in the light of the current knowledge of the epidemiology of the disease, his report is nevertheless interesting because it sheds light on the multifactorial nature of bubonic plague and on the factors that may favour or determine its occurrence and spread in an epidemic form in a given population. RC

Author's Note: The report of Dr. da Silva and other Portuguese works cited in this article were consulted at the library of the Sociedade de Geografia of Lisbon and at the Arquivo Histórico de Macau.

NOTES

1 Besides the medical reports published on the epidemic outbreak (S. J. Thomson, 'The Plague at Hong Kong'; J. A. Lowson, 'Medical Report on Bubonic Plague to the Hong Kong Government'; A. Rennie, 'Report on the Plague Prevailing in Canton During the Spring and Summer of 1894'; J. Cantlie, 'Abstract on an Address on the Spread of Plague'), see W. J. Simpson, *Report on the Causes and Continuance of Plague in Hong Kong and Suggestions as to Remedial Measures*; idem, *A Treatise on Plague Dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease*; E. G. Pryor, 'The Great Plague of Hong Kong'; G. H. Choa, 'The Lowson Diary: A Record of the Early Phases of the Hong Kong Bubonic Plague, 1894'; M. P. Sutphen,'Not What, but Where: Bubonic Plague and the Reception of Germ Theories in Hong Kong and Calcutta, 1894-1897'; M. Echenberg, *Plague Ports. The Global Urban Impact of Bubonic Plague, 1894-1901*, etc.

2 Many wild rodents are now known to be permanent reservoirs of the plague bacillus such as, for example, marmots of Manchuria, Mongolia, Tibet and China; mices, sisels and jerboas of Kurdistan; field rats of India and Indonesia; gerbils and muridae of South Africa; squirrels and prairie dogs in the south-western United States, wild guinea pigs in South America, etc. (N. G. Gratz, 'Rodent Reservoirs and Flea Vectors of Natural Foci of Plague'; M. Echenberg, *Plague Ports*).

3 See A. Yersin, 'La peste bubonique à Hong Kong'. It seems that the Japanese micro-biologist Shibasaburo Kitasato, a disciple of Robert Koch, who was invited by the Hong Kong authorities to study the plague outbreak of 1894, was the first to isolate the plague bacillus. Hearing about the epidemic outbreak, Alexandre Yersin, who was then in India, rushed out to Hong Kong. He isolated the bacillus from the blood and buboes of dead patients and inoculated cultures of the bacillus into small laboratory animals. These soon developed the infection and died from it. Yersin showed that plague disease in humans and rats was caused by the same bacillus and soon published his findings in the French *Annales de l'Institut Pasteur* (Yersin, 'La peste bubonique à Hong Kong'). Kitasato published his results in *Lancet* ('The Bacillus of Bubonic Plague'). After some confusing and contradictory statements made by Kitasato, Yersin was finally recognised as the primary discoverer of the plague bacillus. He named it *Pasteurella pestis* in honor of the Pasteur Institute. In 1967, the name changed to *Yersinia pestis* (on the controversy Yersin-Kitasato, see D. J. Bibel, T. H. Chen, 'Diagnosis of Plague: An Analysis of the Yersin-Kitasato Controversy').

4 The process of transmission of the plague bacillus is very complex: 'When a flea sucks blood from an infected rodent or other host, some of the bacteria settle on the flea's proventriculus. This spined structure shuts off the stomach while the flea is sucking but opens to allow ingested blood to enter the stomach. Plague bacteria that have settled on the spines of the proventriculus multiply and eventually block the passage of blood into the stomach. Although the flea continues to feed (with increasing avidity as time passes) blood cannot continue to enter its stomach and instead remains in the oesophagus. When the flea stops sucking, the oesophagus recoils and the accumulated blood is driven into the bite wound, bringing *Y. pestis* with it. A flea in this condition is known as a 'blocked' flea. Those species of fleas most subject to blocking are the most efficient vectors of plague, providing that the other requirements of transmission are met and that the flea survives long enough to transmit the infection' (N. G. Gratz, 'Rodent Reservoirs and Flea Vectors of Natural Foci of Plague', p. 65).

5 C. Benedict,'Bubonic Plague in Nineteenth-century China'; L. Gross, 'How the Plague Bacillus and its Transmission Through Fleas Were Discovered: Reminiscences from My Years at the Pasteur Institute in Paris'; E. Timokhirov, 'Epidemiology and Distribution of Plague'; N. G. Gratz, 'Rodent Reservoirs and Flea Vectors of Natural Foci of Plague'; Echenberg, *Plague Ports.*

6 N. G. Gratz, 'Rodent Reservoirs and Flea Vectors of Natural Foci of Plague'; Timokhirov, 'Epidemiology and Distribution of Plague'.

7 See P. L. Simond, 'La propagation de la peste'; idem, 'Comment fut mis en évidence le rôle de la puce dans la transmission de la peste'.

8 S. K. Cohn Jr., *The Black Death Transformed: Disease and Culture in Early Renaissance Europe*; M. Echenberg, *Plague Ports.*

9 G. Twigg, *The Black Death: A Biological Reappraisal*, p 114, cited by Benedict, 'Bubonic Plague in Nineteenth-century China', pp. 110-111.

10 K. Park, 'Black Death'.

11 José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau,* p. 8.

12 W. J. Simpson, *Report on the Causes and Continuance of Plague in Hong Kong and Suggestions as to Remedial Measures*; idem, *A Treatise on Plague Dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease.*

13 K. Park,'Black Death'.

14 N. C. Stenseth et al., 'Plague: Past, Present, and Future'.

15 E. Rocher, *La province chinoise du Yün-nan*; W. J. Simpson, *A Treatise on Plague Dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease*; E. G. Pryor, 'The

Great Plague of Hong Kong'; C. Benedict, 'Bubonic Plague in Nineteenth-century China'.

16 E. Rocher, *La province chinoise du Yün-nan*.

17 See, for example, Dr. Mahé, 'Aperçu sur les principales apparitions de la peste depuis les dix dernières années (de 1886 à 1895)'; José Gomes da Silva 'Rapport sur la Peste Bubonique à Macao et Lappa en 1897; Dr. Delay, 'La peste bubonique à Mongtzé'; W. J. Simpson, *A Treatise on Plague Dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease*; M. Echenberg, *Plague Ports.*

18 R. Pollitzer, *The Plague*, p. 26, cited by Benedict,'Bubonic Plague in Nineteenth-century China', p. 108.

19 W. J. Simpson, *Report on the Causes and Continuance of Plague in Hong Kong and Suggestions as to Remedial Measures*; idem, *A Treatise on Plague Dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease*.

20 A. Rennie, 'Report on the Plague Prevailing in Canton During the Spring and Summer of 1894'; W. J. Simpson, *A Treatise on Plague Dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease.*

21 A. Yersin, 'La peste bubonique à Hong Kong'; J. L. Marques, 'Macau: Porto portuguêz na China'; W. J. Simpson, *A Treatise on Plague Dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease*; E. G. Pryor, 'The Great Plague of Hong Kong'; G. H. Choa, 'The Lowson Diary: A Record of the Early Phases of the Hong Kong Bubonic Plague, 1894'.

22 J. A. F. de Moraes Palha, *Macau e a Saúde Pública. Elementos Histórico-Topographicos, Climaticos, Demograficos e Nosograficos*, pp. 76-77.

23 Ibid., p. 84: 'Emquanto essa doença lavra endemo-epidemicamente n'aquelas regiões, atacando indistintamente os indigenas e os europeus, aqui raramente toma o caracter epidemico e algumas vezes nem como endemia se manifesta, como no ano de 1908, em que não se registou um unico caso...; e quasi nunca, ou só por excepção extraordinaria ataca o europeu.'

24 José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau,* p. 17; J. A. F. de Moraes Palha, *Macau e a Saúde Pública*, p. 83.

25 A. de N. Leitão, *Tellurologie et Climatologie Médicales de Macao (Macao Station Climatique). Rapport au 4ème Congrès de Médecine Tropicale de l'Extrême-Orient (Batavia, 1921)*, pp. 68-72.

26 See M. Echenberg, *Plague Ports,* for a comparative analysis of the global impact of bubonic plague in ten cities around the world during the period 1894-1908 and of the responses (general population, press and print media, politicians, medical and public health authorities) to the epidemic disease.

27 S. J. Schrag, P. Wiener, 'Emerging Infectious Diseases: What are the Relative Roles of Ecology and Evolution?'; N. G. Gratz, 'Rodent Reservoirs and Flea Vectors of Natural Foci of Plague'; J. M. Duplantier et al., From the Recent Lessons of the Malagasy Foci towards a Global Understanding of the Factors Involved in Plague Reemergence; N. C. Stenseth et al., 'Plague: Past, Present, and Future'.)

28 José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau*, p. 24.

29 Ibid., p. 3.

30 Ibid., p. 5: 'Quanto á especie da doença, é considerada como peste, da natureza da que teve logar em Londres no anno de 1665; com a differença que alli foi uma verdadeira epidemia extraordinaria, em quanto que no Oriente é, sob a forma endemica e pouco intensa, permanente.'

31 Ibid., pp. 6-7.

32 Ibid., p. 10.

33 Ibid., pp. 7-8.

34 Ibid., pp. 7-8: 'Será que os chinas se alimentem, na época sêcca, d'agua de poços quasi exhaustos e por conseguinte muito mais concentrada em produtos putridos e bacteriologicos, como afinal o é, mais ou menos, toda a agua de poços e mananciaes nas povoações exclusivamente chinezas? Será que as chuvas torrenciaes, lavando as ruas e arrastando para longe das povoações os productos da decomposição, sejam indispensaveis á salubridade de uma povoação chineza, onde, desde a capital do imperio até a mais humilde aldeia, ha o culto instinctivo da immundicie?'

35 Ibid., p. 8.

36 Ibid., p. 14.

37 Ibid., p. 11.

38 See note 3.

39 José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau,* pp. 13-14: 'E não se diga, como argumento, que apezar da existência do Volom não tivemos este anno a visita da peste negra; porque tambem nos annos anteriores não a houve em Hongkong, apezar de existir alli o Taipinxan ha meio seculo. O solo favoravel existia; o que lhe faltou foi a semente que só este anno foi a Hongkong e que para o anno proximo póde por infelicidade vir a Macau .... Se o meio tellurico e atmospherico forem desfavoraveis ao desenvolvimento dos germens da peste, a peste não ha-de manifestar-se. Nem d'outro modo se explica o desapparecimento d'essa epidemia da Europa e na epocha actual a immunidade relativa de Shameen e a immunidade absoluta de Macau. O bairro Volom, um meio precioso para a cultura do bacillo Kitasato, estava no coração da cidade, defendido pelo cordão sanitario e pelas inspecções médicas; a semente da epidemia não pôde chegar até lá. É possivel que se o bairro ainda existir para o anno, succeda o mesmo...; e é sobretudo muito mais seguro que, se o terreno favoravel faltar, a semente, ainda que venha, não germinará.'

40 See, for example, the report on the health services of Macao for the year 1874 of Dr. Lúcio Augusto da Silva, *Duas Palavras sobre a Dengue pelo Dr. Lúcio Augusto da Silva. Relatorio do Serviço de Saude Publica na Cidade de Macau Relativo ao Anno de 1874*, p. 15. See also José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau,* pp. 13-14.

41 Ibid., pp. 41-42, and 44.

42 Ibid., pp. 23-25, and 30.

43 In fact, only sporadic cases of plague have been registered in Hong Kong in 1895.

44 José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau,* pp. 24-25.

45 Ibid., pp. 27-28.

46 Ibid., p. 30: 'Os caixões mortuarios conduzidos a toda hora atravez das ruas da cidade; os postos de desinfecção com as fogueiras permanentes; as portas fechadas de grande numero de estabelecimentos e lojas chinezas, não só no Bazar, mas até nas ruas principaes da cidade (Rua Central, S. Domingos); o terror de que estava possuida a maioria dos habitantes de Macau; todas estas circumstancias reunidas davam á cidade um aspecto lugubre e desolador; que, se não era comparavel ao que offerecia Hongkong no anno anterior durante a epidemia de peste bubonica, tinha todavia o cunho particular dos grandes males que assolam por vezes os centros de população densa e pouca respeitadora da hygiene.'

47 Ibid., p. 32: 'De facto, cada empestado removido era um foco epidemico de que se expurgava a cidade. O doente levava consigo o pus dos bubões e a diarrhea infecciosa; depois, quando morresse, não iria engrossar as fileiras de caixões mortuarios que percorriam as ruas e estradas de Macau, a caminho das Portas do Cêrco'. The *Porta dos Cercos* is the Border Gate between Macao and the mainland of China.

48 Ibid., p. 31.

49 The barrack-hospital of Lapa was initially destined to receive only plague-stricken patients and/or suspected cases of the disease. However, soon after its opening, Chinese afflicted from other diseases came to the barrack-hospital in search of a treatment (José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau*, p. 54).

50 José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau*, pp. 31-36.
51 Ibid, p. 14.
52 See ibid., pp. 18-19.
53 Ibid, p. 53: 'A peste bubonica... é hoje ainda combatida pelos medicos europeus com um tractamento symptomatico. Se o meio interno e externo do doente permittem que o organismo reaja contra os effeitos immediatos do envenenamento do sangue e espere a eliminação das bacterias e toxinas da peste, o doente salva-se; no caso contrario, morre, quer o tractamento symptomatico seja racional, quer absurdo, quer prescripto pela mão intelligente do medico, quer administrado pela mão inconsciente do curandeiro.'
54 Ibid., p. 82: 'Basta que todos se convençam da utilidade da hygiene e da sua incontestavel supremacia sobre a therapeutica.'
55 A. Yersin, 'La peste bubonique à Hong Kong'.
56 P. L. Simond, 'Comment fut mis en évidence le rôle de la puce dans la transmission de la peste', pp. 7-8, cited by H. H. Mollaret, 'La découverte par Paul-Louis Simond du rôle de la puce dans la transmission de la peste', p. 1947: 'Le virus émis avec les excréments des malades, humains et rats, une fois répandu sur le sol et mélangé aux poussières, arrivait pas mille moyens au contact de la peau et des muqueuses et pénétrait dans l'organisme, soit accompagnant les aliments (on admettait une forme intestinale de la peste), soit avec l'air inspiré, soit par les excoriations de la peau. On expliquait par exemple la grande fréquence des cas indigènes par l'habitude de la marche nu-pieds qui favorisait la pénétration du virus par les excoriations multiples des membres inférieurs chez les Hindous.'
57 Infectious diseases transmissible... 'são devidas á presença de bacillos que se criam ou se desenvolvem no sangue do homem e cujo poder diffusivo é eminentemente favorecido pela accumulação de individuos, pela falta de prophylaxia, pela acçao complexa do meio externo e do meio interno, a qual cria as immunidades e determina as predisposições. Quando grassa uma doença d'este grupo, a agua que se bebe e o ar que se respira são inquinados pelos bacillos dimanados do doente, que póde assim, d'um modo indirecto – mas só indirecto – transmitir a doença ao individuo são, que bebe ou respira a agua ou o ar infectados. Se é certo que as immunidades se manifestam, em todas estas epidemias, em individuos vivendo em contacto directo com os infectados, não é menos certo que as fórmas graves d'estas doenças só se manifestam em condições de meio externo e interno, particulares para cada especie morbida d'este grupo. Assim, uma simples diarrhea, que em tempos de peste não teria significação ou tel-a-ia favoravel n'um individuo com saude, tornar-se-á, sob uma epidemia de cholera, uma predisposição grave para a installação do bacillo cholerigeno. Emquanto que a peste e a febre amarella preferem para a sua manifestação os climas quentes e humidos, a influenza torna-se mais mortifera no inverno dos climas temperados. A influencia do meio é pois incontestavel, embora as condições sejam especiaes para cada uma d'essas epidemias.' (José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau*, pp. 61-62).
58 Ibid., pp. 63 and 65.
59 Ibid., pp. 66-67.
60 Ibid., p. 67.
61 José Gomes da Silva, 'Rapport sur la Peste Bubonique à Macao et Lappa en 1897', pp. 17-18.
62 José Gomes da Silva, *A Epidemia de Peste Bubonica em Macau*, p. 68: 'É que na Horta de S. Paulo havia a immundicie com todos os seus horrores, mas havia tambem luz e ar; porque o local, na vertente d'uma collina, é batido do sol e dos ventos e encontra facil e natural escoadouro ás torrentes pluviaes; ao passo que na Praia Manduco, baixa e abrigada dos ventos, povoada de becos escusos, alguns d'elles sem saida, o bacillo da peste encontrou condições mais favoraveis ao seu desenvolvimento, talvez mais demorado e por isso mesmo mais prejudicial nos seus effeitos.'
63 Ibid., pp. 66-70.
64 Ibid., p. 123.
65 See, for example, A. Hirsch,'Plague'; Dr. Delay, 'La peste bubonique à Mongtzé; W. J. Simpson, *A Treatise on Plague Dealing with the Historical, Epidemiological, Clinical, Therapeutic and Preventive Aspects of the Disease*; J. A. F. de Moraes Palha, *Macau e a Saúde Pública*; etc.).

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