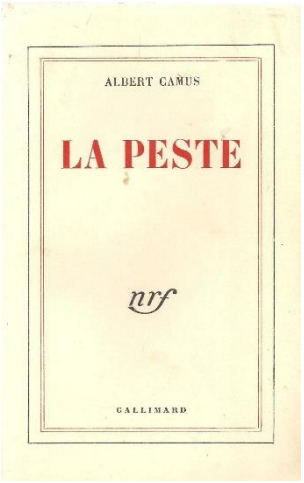
The SMALTIS'tory – episode #6

War & Plague



Once upon a time there was the Plague, a disease common to both animals and humans (an anthropozoonosis), which has caused serious pandemics throughout history.

Common in rodents and transmissible to humans through fleas, this pathology can be developed as two different forms. The first, bubonic plague, occurs after an infected parasite bites a healthy person inoculating the pathogen into a lymph node, where it multiplies. The latter most often located in the groin, will then swell to form a bubo. In some cases, the pathogen can reach the lungs and the subjects then contract the second form of the pathology: pulmonary plague. This is the most contagious form of the disease because of its transmission directly from human to human through saliva. It is also the most serious form since the disease rapidly progresses to death.

But which pathogen can be responsible for such a pathology? It was in 1894 in Hong Kong that Alexander Yersin isolated the plague bacillus from human and rodent corpses. As a tribute to the Swiss doctor, this enterobacteria was named *Yersinia pestis*. Prior to its discovery, the latter had already caused two other major pandemics. The first one, Justinian's plague, occurred throughout the Mediterranean basin between 541 and 767, decimating between 25 and 50 million people. The role of *Y. pestis* in this pandemic was confirmed in 2012 through paleo-microbiological work. Indeed, using dental pulp taken from corpses in a pestiferous cemetery in Bavaria, Holger C. Scholz's team showed the presence of antigens specific to the bacterial species. The second, the Black Death, invaded all of Europe in the 14th century, and the first wave is estimated to have killed almost 25 million people.

But how could this bacterium have caused so many victims? The answer lies in its extraordinary ability to multiply rapidly within the tissues of the infected host. Indeed, the bacterium can produce an arsenal of virulence factors that promote its extracellular replication while inhibiting the host's innate immunity. Most of these factors are encoded by genes present on three plasmids. The first, plasmid pCD (*Calcium-Dependency*), codes for Yop effector proteins (*Yersinia outer proteins*) that allow bacteria to remain extracellular and escape phagocytosis. The second, called pPCP, carries the *pla* (*plasminogen activator*) gene that promotes the spread of bacteria from the inoculation site. Finally, the third, the plasmid pMT (*Murine Toxin*), codes for a surface glycoprotein capsule that gives the bacillus resistance to phagocytosis by inhibiting its opsonization.

The plague is so far the disease which, in history, is responsible for the greatest number of deaths, ahead of other great lightning pandemics such as the Spanish flu which caused at least 50 million victims in one year. It was antibiotics, and in particular streptomycin, which in the 20th century finally made it possible to significantly reduce the morbidity and mortality caused by this infection. However, the plague still rages today in Africa, Asia and America.

Pending the development of an effective vaccine, public health measures remain man's most effective weapon...