BACKGROUND ON PLAGUE ("BLACK DEATH")

Medieval astrologers blamed the Black Death on a malign conjunction of Saturn, Jupiter, and Mars; epidemiologists now trace the cause of the epidemic plague to an unfortunate conjunction of Yersinia pestis, fleas, and rats. A brief overview of the complex ecological relationships of microbes, fleas, rodents and human beings will help us understand the medieval pandemics, the waves of plague that continued well into the seventeenth century, and the status of plague today. It is worth discussing the components of this web of relationships in order to dispel the notion that discovering the "cause" of the epidemic disease is a simple matter of naming the microbe involved and as a reminder that rodents, fleas, mosquitoes, ticks, and microbes are still part of the web of life. Moreover, the magnitude of the pandemics caused by bubonic plague is an instructive lesson about how powerful a force disease can be in human history. Such reminders are essential now that molecular biologists are able to identify, isolate, and manipulate the genetic factors responsible for the awesome virulence of the microbes that cause bubonic plague and other epidemic diseases.

Plague provides an interesting example of the way in which a specific microbe can cause different clinical patterns. In this case, the major forms of illness are known as bubonic and pneumonic plague. In the absence of appropriate antibiotics, the mortality rate from bubonic plague may exceed 50%; the deadly pneumonic form probably kills 100% of its victims. Even today, despite streptomycin, tetracycline, and chloramphenicol, many plague victims succumb to the disease.

If the plague bacillus enters the body via the bite of an infected flea, the disease follows the pattern known as bubonic. After an incubation period of about 6 days, victims suddenly experience pains in the chest, coughing, difficulty in breathing, vomiting of blood, high fever, and dark splotches on the skin. The most characteristic signs of bubonic plague are the hard, painful swellings called "buboes" that appear in the lymph nodes, usually in the groin, armpit, neck, and behind the ears. Restlessness, anxiety, headaches, mental confusion, hallucinations, and finally coma and death may follow. In some cases, referred to as septicemic plague, the patient may rapidly weaken, become delirious or comatose, and die in 1-3 days without the appearance of buboes.

Spread directly from person to person by droplets of saliva, pneumonic plague is highly contagious and exceptionally lethal. Just what circumstances lead to the transformation of bubonic plague to the pneumonic form is uncertain. However, if victims of bubonic plague develop pulmonary abscesses, their fits of coughing will release hordes of bacteria. When inhaled, the bacteria make their way through the mucous membranes to spread and multiply in their new hosts, who are classified as victims of primary pneumonic plague. The incubation period for pneumonic plague is usually only 1-3 days and the onset of symptoms is very abrupt. Pain in the chest is accompanied by violent coughing which brings up

bloody sputum. Neurological disorders progress rapidly and incapacitate the victim. Hemorrhages under the skin produce dark purple blotches. Coughing and choking, the patient finally suffocates and dies.

As if to provide unequivocal proof that plague was not a medieval disease, bubonic plague swept across Asia in the 1890s, from Canton to Hong Kong to Bombay, killing about one million people in India in 1903, while invading Java, Japan, Asia Minor, South Africa, the shores of North and South America, Portugal, Austria, and parts of Russia. Alexandre Yersin (1863-1943) discovered the plague bacillus during an outbreak in Hong Kong in 1894. Shibasaburo Kitasato (1852-1931), studying the same outbreak for the Japanese government, also contributed to early studies of the bacterium. Originally called Pasteurella pestis, the plague bacillus was renamed Yersinia pestis in honor of Yersin.

From Lois N. Magner, *A History of Medicine* (New York: Marcel Dekker, 1992), pp. 114-116.

Los Angeles Plague of 1924-25 Worst U.S. outbreak of pneumonic plague (also the last such occurrence in an American urban environment) and the last time an American plague epidemic would involve rats. During the outbreak, 31 of the 33 pneumonic plague cases were fatal, while five out of the eight people infected with the bubonic plague died. The epidemic took place in the Mexican section of Los Angeles, where the first victim, a Mexican, fell ill on October 1, 1924, and developed a femoral bubo originally diagnosed as venereal disease. Although he recovered, his daughter and others in his neighborhood fell ill and died. By October 28, 15 people were infected, and all of them died within three days. There were seven more plague victims on October 29. The epidemic in Los Angeles was underway. The victims complained of plague symptoms like stupor, high fever and chills, headaches, and, most important, very large, lymphatic swellings under their arms, in the neck, or in the groin.

A doctor examined a patient in Los Angeles's Mexican section in 1924 without diagnosing the plague; the patient and 13 others were then sent to the Los Angeles County General Hospital, which contacted the state and federal government for vaccine and plague serum. Later, a local health official informed the U.S. government of the ongoing epidemic. Only very distorted accounts appeared in newspapers, which frequently classified the disease as "malignant pneumonia."

Most of the deaths from plague had already occurred by the time sanitation and public health measures were instituted. The plague-ridden area of the city was isolated and food portions given to the frightened residents, who were informed of their predicaments. Although the serum arrived, it was used only on one patient. By November 1924, a campaign against rats was undertaken in the city close to the harbor, rather than in the Mexican section, to forestall a port

quarantine that could disrupt business. Eventually, a harbor quarantine took place anyway. By early 1925, the plague epidemic had ended.

Indian Plague of 1994. Unexpected outburst of bubonic and pneumonic plague in India in September 1994. Transmitted by fleas that infest rats, the bubonic form of the bacterial disease first erupted in Maharashtra state in west central India, where many rats were drawn by relief grain and other stockpiled food sent there after severe earthquakes in 1993 that killed some 10,000 people.

Public health officials at first seemed to downplay the danger of the disease, undoubtedly to avoid panic in Bombay, the capital of Maharashtra and India's largest city with more than 12.5 million inhabitants. However, on September 20, 1994, Indians began dying from pneumonic plague (a more deadly strain of the bubonic plague) which is spread via coughs and droplets of contaminated saliva exhaled by infected individuals, in the port city of Surat, about 150 miles north of Bombay. In less than a week, about 200,000 panicky residents of Surat (with a population of more than 1.5 million) fled the city in jammed trains and buses, usually heading south to Bombay. Even doctors fled Surat by the hundreds.

Alarmed that Surat refugees would carry the plague into Bombay's rat-infested shantytowns and slums, health officials undertook swift rat-control and disease-control measures, such as stockpiling tetracycline and other antibiotics. Officials urged calm, but cases of plague began to be reported in Bombay, New Delhi (north central India), and Calcutta (northeast India). There were increased efforts to find and treat the sick, along with increased availability of antibiotics in pharmacies.

By October 1, health officials and the World Health Organization reported that plague had eased and was under control in India, and yet many citizens and authorities remained fearful that the estimated 400,000 people who had fled Surat by then would continue to spread the disease throughout the country. At least 54 people had died of plague in Surat, and unofficial estimates put the death toll as high as 300. Some families reportedly cremated or buried suspected plague victims without reporting the deaths.

This epidemic of plague once again raised much concern about the old Hindu practice of rat worship in India. Like cows, rats are deified in Hindu temples; no Hindu worship is complete without an offering to the elephant-headed god Ganesha (or Ganesa), who is accompanied by a rat whenever he travels about. In the early morning in many towns and cities in India, men and women can be seen carrying rats in traps and releasing them at a distance from their homes. Indians rarely kill rats, which many health officials consider a deadly menace that must be eradicated to escape plagues in the fYork: Facts on File, 1995), pp. 146 (India), 192-193 (Los Angeles).