

Chapter 1 Significant Historical Events in Microbiology

A. General information

1. Scientists have studied microorganisms for more than 400 years
2. Their study has been enhanced by the invention of such instruments as the microscope
3. From the 16th century to the present, many theories have been developed about the growth and control of microorganisms

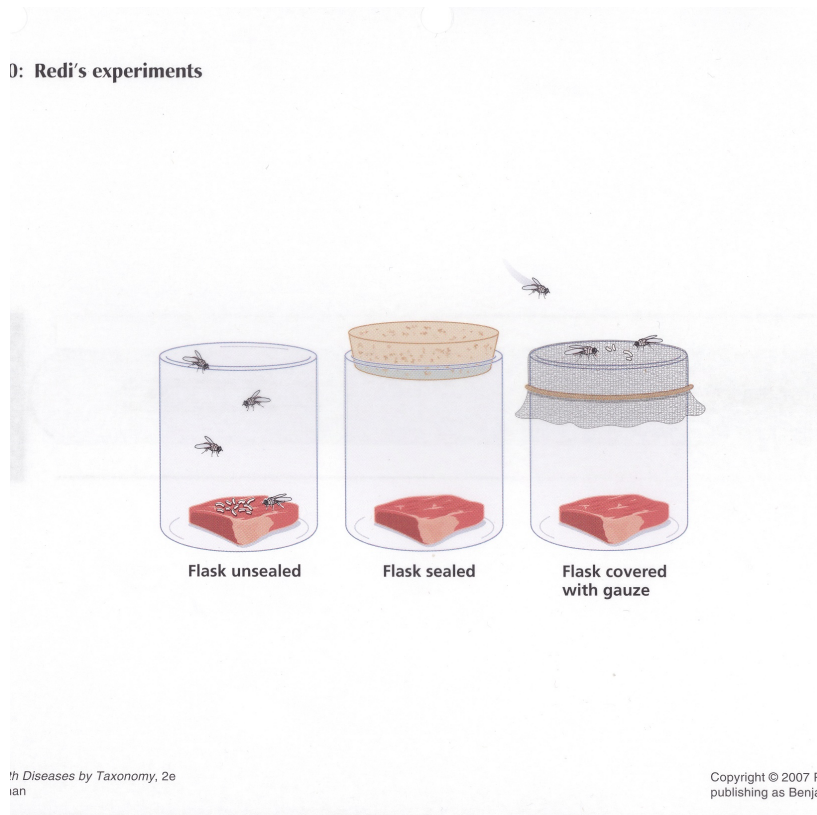
B. 16th century

1. In 1546, **Girolamo Fracastoro** proposed the theory of contagious diseases
 - a. He believed that diseases were spread through contact between individuals
 - b. He developed this theory while treating cases of syphilis
2. In 1590, **Johannes and Zacharias Janssen** invented the first compound microscope (one having two sets of lenses)
 - a. The Janssens used sunlight to illuminate the object under study
 - b. Their microscope achieved magnifications of 10 to 100 times the object's actual size

C. 17th century: **The debate of Spontaneous Generation begins**

1. In 1660's **Francesco Redi** demonstrated that maggots resulted from flies laying eggs on rotting meat and not by spontaneous generation.
 - a. He covered jars of rotting meat covered with cloth to jars of rotting meat uncovered.
 - b. His work was not universally accepted except for another experiment 100 years later.

0: Redi's experiments



2. In 1665, **Robert Hooke** advanced the cell theory of biology
 - a. Hooke studied fungi and discovered cells
 - b. He proposed that cells are the basic unit of all living things: Beginning of the cell theory - that all living creatures are composed of cells

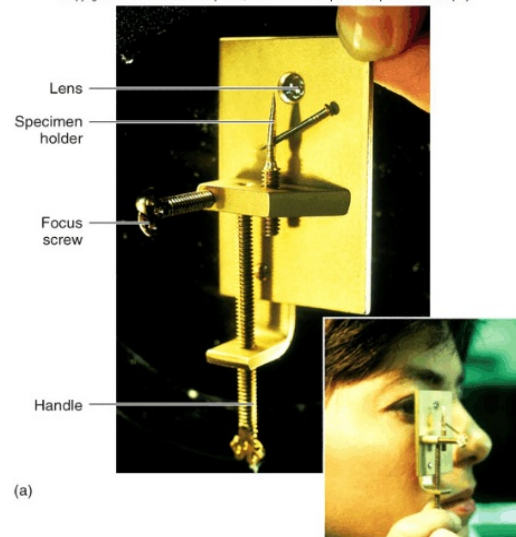
3. In 1674, **Antonie van Leeuwenhoek** used a microscope to describe microorganisms
 - a. Leeuwenhoek developed lenses capable of magnifying an object up to 270 times its actual size
 - b. He examined pond water and mouth scrapings to discover and record microorganisms

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Antonie van Leeuwenhoek

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D. 18th century: **Debate over Spontaneous Generation continues**

1. From 1740 to 1776, **John Needham, and Lazzaro Spallanzani** performed experiments involving spontaneous generation (life developing from nonliving materials)
 - a. In these experiments, various media grew microorganisms only when exposed to air, a source of bacteria and molds
 - b. They theorized that all life came from existing life forms requiring some vital force (later to be shown to be oxygen)
 - (1) Heating flask materials only destroyed some vital force necessary for spontaneous generation

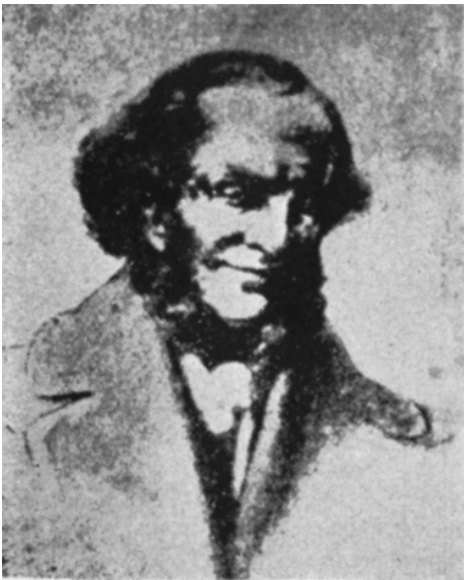
2. Edward Jenner 1798

Jenner helped developed a vaccine for smallpox.

- a. Jenner noted the similarity between smallpox and cowpox
- b. He discovered that vaccination with the live virus of cowpox protected individuals from smallpox



Edward Jenner



Agostino Bassi

3. Agostino Bassi (1773 - 1856)

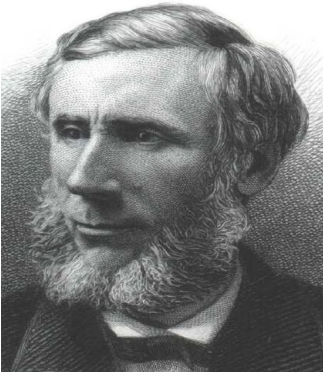
He discovery that microorganisms can be the cause of disease (stage set for the germ theory of disease). He discovered that the muscardine disease of silkworms was caused by a living, very small, parasitic organism, a fungus that would be named eventually *Beauveria bassiana* in his honor. In 1844, he stated the idea that not only animal(insect), but also human diseases are caused by other living microorganisms; for example, measles, syphilis, and the plague.

4. Theodor Schwann (1839)

Theodor Schwann also examined the question of spontaneous generation, which led to its eventual disproof. In the course of his experiments, he discovered the organic nature of yeast. In fact, the whole germ theory of Pasteur, as well as its antiseptic applications by Lister, can be traced to Schwann's influence.



Theordor Schwann



John Tyndall

5. John Tyndall (2 August 1820 – 4 December 1893)
English physicist provide initial evidence that some of the microbes in dust and the air have high heat resistance requiring vigorous treatment to destroy them.

6. Ferdinand Julius Cohn (24 January 1828 – 25 June 1898)
Botanist/ Biologist

Cohn first described bacterial endospores clarifying the reason why heat treatment sometimes failed to completely eliminate all microorganisms.



Ferdinand Cohn

E. 19th century: **Development of Germ Theory of Disease**

1. In 1866, **Louis Pasteur** developed the process now known as pasteurization
 - a. Pasteurization uses moderate heat (below boiling) to destroy harmful microorganisms
 - b. This process does not chemically alter the substance being pasteurized

2. Between 1880 and 1885, Louis Pasteur developed vaccines



Louis Pasteur



- a. Pasteur worked with cholera and anthrax (bacterial infections) and rabies (a viral infection)
- b. He found that attenuated (weakened) organisms could not cause infection but would produce immunity

3. Florence Nightingale (1855)

Florence Nightingale's most famous contribution came during the Crimean War, which became her central focus when reports began to filter back to Britain about the horrific conditions for the wounded.

- a. Florence Nightingale advocated sanitary living conditions as of great importance.
- b. She reduced deaths in the Army during peacetime and turned attention to the sanitary design of hospitals
- c. As a consequence detailed reports to the British Royal Medical Commission a major report led to a major overhaul of army military care, and to the establishment of an British Army Medical School and of a comprehensive system of army medical records.



Florence Nightingale



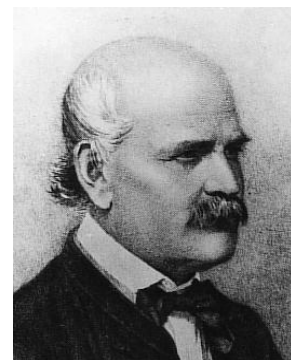
Joseph Lister

4. In 1867, **Joseph Lister** began using antiseptics in surgery

- a. Lister experimented with the then-developing concept that microorganisms cause disease
- b. He used phenol as an antiseptic on surgical wounds

5. Ignaz Semmelweis (1861)

- a. Semmelweis discovered in 1847 that hand washing with chlorinated lime solutions reduced the incidence of fatal puerperal fever from about 12 percent to about 2 percent. At the time, diseases were attributed to many different and unrelated causes.



Ignaz Semmelweis

6. In 1882, **Robert Koch** discovered the cause of tuberculosis and anthrax
- a. Tuberculosis is caused by a bacterium
 - b. He became famous for isolating *Bacillus anthracis* (1877). Koch found anthrax built persisting endospores increasing its survival odds.
 - b. Koch's studies led to the germ theory of disease
 - c. Koch's developed postulates establishing a specific microbe as the cause of an infective disease:

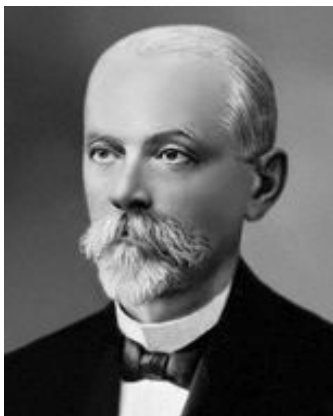


Robert Koch

Koch Postulate state:

1. The microbial agent must be present in every case of the disease host and absent in healthy host
2. The agent must be isolated from diseased host and cultured in vitro onto pure culture medium.
3. The disease must be reproduced when a pure culture of the agent is inoculated into a similar susceptible host.
4. The agent must be recoverable from the experimentally-infected host and isolated to pure culture

7. Dmitri Iwanowski (1890's)



Dmitri Iwanowski

He discovered that both diseases were caused by an infinitely minuscule agent, the tobacco mosaic virus, capable of permeating porcelain filters, something which bacteria could never do. He described his findings in an article (1892) and a dissertation (1902)

7. In 1900, **Walter Reed**

He demonstrated that mosquitoes transmitted yellow fever

- a. Yellow fever is caused by a virus
- b. The infection caused many deaths in the United States and Central America before being controlled through eradication of the mosquitoes that carried it
- c. His insights helped open entire new fields of epidemiology and bio medicine and most immediately allowed the resumption and completion of work on the Panama Canal (1904-14) by the United States.



Walter Reed

F. 20th century

1. In 1908, **Paul Ehrlich** introduced chemotherapy



Paul Ehrlich

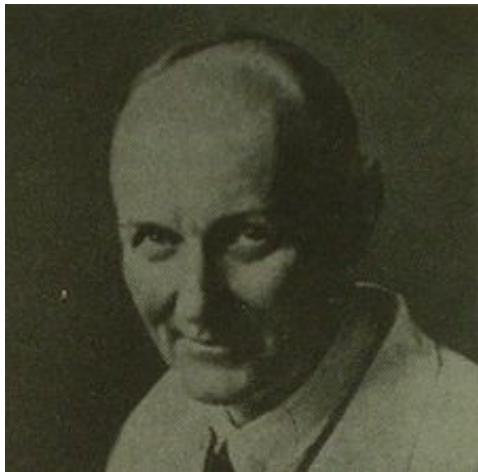
- a. Ehrlich sought a treatment for syphilis; He coined the term "chemotherapy" and the concept of a "magic bullet."
- b. He developed Salvarsan, an arsenic compound that was specific and effective against syphilis.
- c. He is credited with the first empirical observation of the blood-brain barrier and the development of the first antibiotic drug in modern medicine.

2. In 1929, Alexander Fleming was a Scottish biologist and pharmacologist. He discovered antibiotics

- a. He made this discovery while working with a culture of *Staphylococcus aureus* that had become contaminated with the *Penicillium notatum*
- b. After noting that the mold inhibited the growth of the bacteria, Fleming isolated the antibiotic penicillin
- c. He investigated its positive anti-bacterial effect on many organisms, and noticed that it affected bacteria such as staphylococci, and many Gram-positive pathogens (scarlet fever, pneumonia, gonorrhoea, meningitis, diphtheria) but not typhoid or paratyphoid (Gram negative bacteria).
- d. Another decade followed before the active compound was extracted and purified from *Penicillium* by Howard Florey and Ernst Chain.



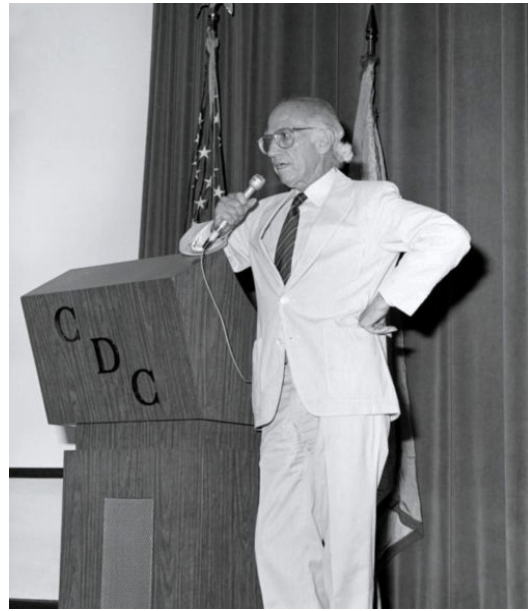
Alexander Fleming



3. Gerhard Johannes Paul Domagk (1932)
- a. Domagk was a German pathologist and bacteriologist credited with the discovery of Sulfonamidochrysoidine – the first commercially available antibacterial antibiotic for which he received the 1939 Nobel Prize in Physiology or Medicine.
 - b. He found the sulfonamide Prontosil to be effective against streptococcus, and treated his own daughter with it, saving her the amputation of an arm.

4. In 1933, Ernst Ruska developed the electron microscope
- a. To illuminate objects for study, Ruska used a beam of electrons rather than sunlight, focusing the beam with electrical lenses
 - b. The electron microscope has permitted scientists to magnify an object millions of times its actual size

5. In 1952, Jonas Salk tested a vaccine against polio
- a. Polio is caused by a virus
 - b. Salk killed the polio virus, but kept it intact enough to trigger the necessary immune response.
 - c. In 1916 left about 6000 dead and 27,000 paralyzed in the United States. In 1952, 57,628 cases were recorded in the U.S
 - d. After 1955 when the vaccine became available, polio cases in the U.S. dropped by 85-90 percent in only two years.



Jonas Salk

6. From 1953 to the present, researchers have continued to apply the techniques of microbiology in order to define new infections—such as those that cause Legionnaire’s disease and acquired immunodeficiency syndrome—and to pursue effective treatments and methods of prevention

Study Activities

1. Describe at least five ways in which microorganisms benefit humans. How many benefits did you know about before studying the issue?
2. Identify two organisms that share a symbiotic relationship of mutualism, and summarize the various benefits that each organism derives from the other.
3. Form a discussion group with your classmates to research and debate the following questions:
How did Louis Pasteur influence the work of Joseph Lister and Robert Koch? Which aspects of contemporary life would be different without the efforts of Walter Reed, Paul Ehrlich, and Alexander Fleming?
4. What are Kock's postulates? How has Kock's postulates influenced modern medicine? Does Kock's postulates work for all microbial conditions? Explain.
5. List four significant discoveries in microbiology that would not have been possible before Ernst Ruska developed the electron microscope in 1933.

Pasteur's Experiment

