

Historical Perspective of Microbiology

1. Ancient History: (pre-1660's) – The Age of Sanitation

- Early civilizations (e.g., Crete, India, Pakistan, and Scotland) showed signs of using toilets and sewers dating back as far as 2800 BC.
- The first cities to use Water Pipes made of clay were in the Indus Valley of India around 2700 BC and in the palace of Knossos on Crete around 2000 BC. Metal pipes were used in Egypt as far back as 2450 BC.
- The Romans in 315 AD had public lavatories where people routinely socialized and conducted business. Rome also built elaborate aqueducts and public fountains and had an appointed water commissioner who was responsible for seeing that the water supply was kept clean. Lead was commonly used for Roman pipes and the subsequent fall of the Roman empire has been related by some to this practice.
- The Chinese as early as 589 AD produced toilet paper, while Europeans were using moss and hay.

2. Early History: (1660's to 1850's) – The Age of Discovery

- 1665: **Robert Hooke** – The first person to report seeing MO's under a microscope. He saw the cellular structure of plants and fungi, but his lens were apparently too poor to “see” bacteria.
- 1668: **Francesco Redi** – The first serious attack on the idea of spontaneous generation was made. Redi's experiment proved maggots are not spontaneously produced in rotten meat.
- 1684: **Anton van Leeuwenhoek** – The first to see and describe bacteria and their characteristic morphology. Publishes his drawings of “wee animalcules.” Classic example of serendipity, he originally wanting better magnification to judge the quality of cloth.

- Takes 175 years before any major advancements are made.
 1. Technology of producing better microscopes and chemistry.
 2. Leeuwenhoek did not allow others to reproduce and verify his results.
 3. The nature of contagious disease is still paramount.
 4. The question of spontaneous generation lingers.

- 1798: **Edward Jenner** introduces the concepts of vaccination using cowpox material to prevent small pox, unfortunately many questions left unanswered.

- 1804-1806: The Lewis and Clark Expedition.

3. Microbiology's Renaissance: (1850's to 1920's) – The Age of Diagnoses

- 1859: **Louis Pasteur** settles the question of spontaneous generation once and for all with “simple” experiments using swan necked flasks. Microbiology becomes a truly scientific discipline as MO's are now known to have the same fundamental properties as other living organisms.

- He contributed to the development of the first vaccines for the immunization against rabies, anthrax, and chicken cholera. He described the scientific basis for fermentation, wine-making, and the brewing of beer. And don't forget Pasteurization, which was originally used to prevent Napoleon's sailors from mutiny and the production of canned food for his armies!

- 1859: Charles Darwin publishes the Origin of the species.

- 1861-1865: United States Civil War.

- 1867: **Joseph Lister** – Revolutionized medicine by introducing practices to limit the exposure to infectious MO's during surgery. Developed antiseptic methods for preventing infection using phenol (toxic!) to treat wounds.

- 1876: **Robert Koch** – Established the relationship between MO's and infectious disease. Determined Koch's postulates. Discovered causative agent for anthrax, tuberculosis, and cholera. His discoveries, in combination with those of Pasteur, established the **Germ Theory** of disease.

- 1881: **Paul Ehrlich** (working in Koch's lab) introduces vital staining with methylene blue and the visualization of bacteria is greatly improved. Later credited for early work with chemotherapy (chemicals to treat disease).
- 1882: **Walter Hesse (and wife Fannie)** – uses Agar as solid growth medium.
- 1884: **Hans Christian Gram** develops a differential staining method, which exploits the difference between two basic variations in cell wall structure and is still essential in the classification of bacteria.
- 1884: Mark Twain writes Huckleberry Finn. Koch's Postulates are published.
- 1887: **Richard Petri** – describes the utility of the Petri dish.
- 1889-91: **Sergei Winogradsky and Martinus Beijerinck** – cofounders of microbial ecology, each made significant discoveries concerning microbial transformations of inorganic compounds. First to develop ideas in biogeochemical cycling on a global scale. **Winogradsky** isolated and described nitrifying bacteria NH_4^+ to NO_2^- and NO_3^- (cations to anions) and other oxidation reactions including S and Fe and anaerobic N-fixing bacteria. Famous for Winogradsky column used to study anaerobic photosynthesis. **Beijerinck** established enrichment culture techniques for the isolation of pure cultures. Isolated anaerobic sulfate reducing bacteria and symbiotic and non-symbiotic aerobic N-fixing bacteria. Famous for the statement: "Everything is everywhere, the environment selects."

4. Modern History: (1920's to Present) – The Age of Biotechnology

- 1929: **Alexander Flemming** discovers penicillin. An antibiotic produced by a fungus that inhibits bacterial growth.
- 1928: **Fred Griffith** – transforms *Streptococcus pneumoniae*.
- 1933: Invention of the electron microscope.
- 1937: First division of living organisms into prokaryotes and eukaryotes.

- 1940s: **Beadle and Tatum** – One gene-one enzyme hypothesis.
- 1941: **Oswald Avery** – DNA is the genetic material.
- 1953: **Watson and Crick** – DNA structure as double helix.
- 1960s: **Jacob and Monod** – Operon theory, control over enzyme expression.
- 1969: First Man on the Moon – Apollo 11, Neil Armstrong and Buzz Aldrin.
- 1977: **Fred Sanger** – DNA sequencing techniques. Discoveries of both Archaea (archaebacteria) and hydrothermal vents with the submersible Alvin.
- 1980's: Genetic manipulation and cloning (PCR).
 AIDS and causative agent HIV.
 Ribozymes or catalytic RNAs.
 RNAs used historical documents – Molecular phylogeny reshapes biological systematics to 3 domains.
- 1990's: GEMs or genetically engineered microorganisms.
 Prions or specific protein pathogens.
 Dolly the sheep.
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“The microbes will have the last word” – Louis Pasteur