

Origins of Microbiology

Dr. Anupam Porwal
Department of Biotechnology



Outline

- Cells and cell theory
- Microbes and Germ Theory
- Classic Age of Microbiology
 - Fermentation
 - Pasteurization
 - Vaccines

Filename: history.ppt

Primitive health codes

- Laws of Moses (Numbers, Deuteronomy)
- Venereal diseases
 - acquired from infected individuals
 - **kill infected individual**
- Trichinosis
 - lack of fuel
 - Undercooked pork spreads the parasite
 - **ban eating of pork**

First Observations

- Robert Hooke cells
- Leeuwenhoek: microbes

Micrographia

- Robert Hooke
- First report of cell structure 1665
- 'Little boxes' in cork : **CELL**

First illustrated
book on
microscopy



Anton Van Leeuwenhoek

- First person to see bacteria
- Single lens microscope



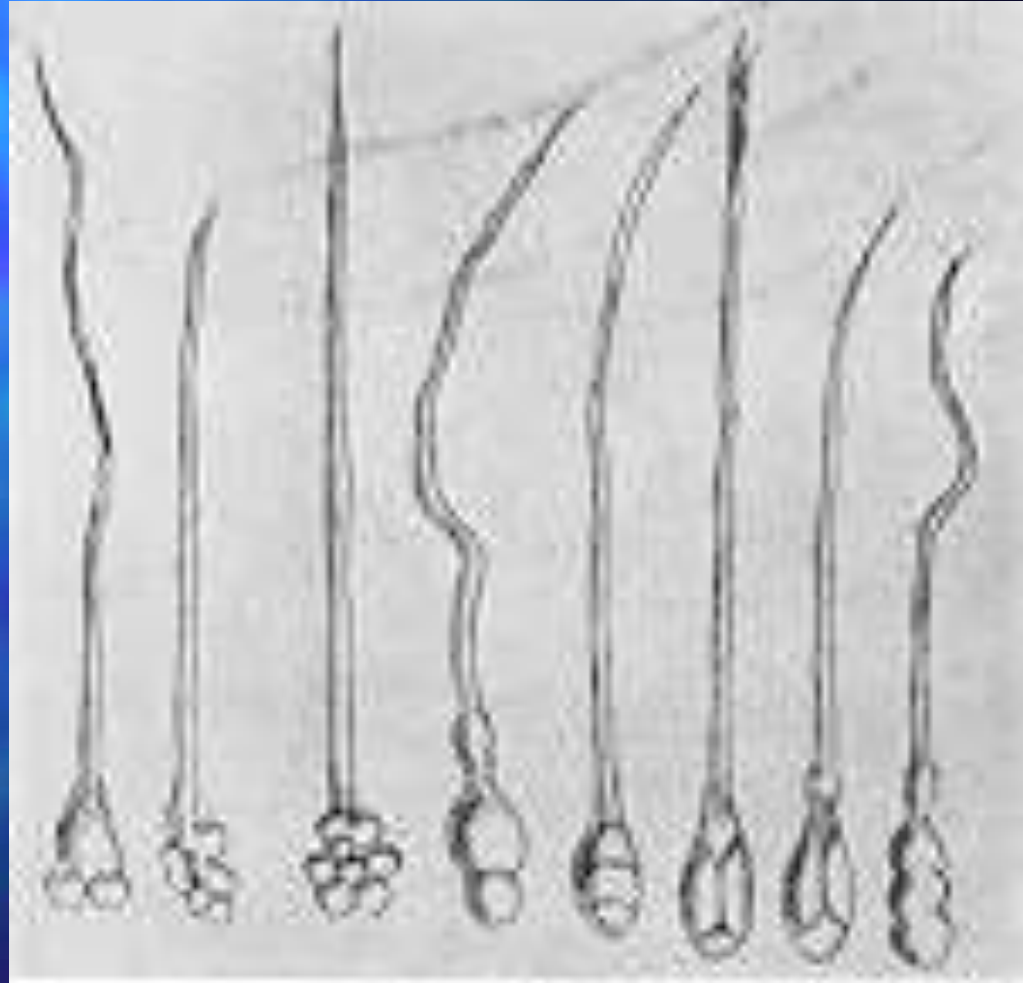
Early Compound Microscope

- beautifully crafted but had severe chromatic distortion



Simple microscopes gave better resolution

- Spermatozoa from man & dog
- Leeuwenhoek
- 1678



Spontaneous Generation *VS* Biogenesis The Great Debate

- Redi (1668)
- Needham (1745)
- Spallanzani (1765)
- Virchow (1858)
- Pouchet (1859)
- Pasteur(1861)

Spontaneous Generation

- **Aristotle: any damp body gives rise to living things**
 - Miasma
 - phoenix myths
 - “Golam”
- **Herodotus: Living organisms could arise from non living matter**
 - crocodiles from mud
- **Van Helmont: small animals only**
 - maggots from meat
 - mice from feed

Francesco Redi

- Italian poet physician 1668
- **Tested** hypothesis of Spontaneous Generation
 - Meat in jars
 - three jars open to air > **maggots**
 - three jars sealed > no maggots
 - three jars fine net > no maggots
- **Concluded** spontaneous generation did not still occur

John Needham

- Irish priest 1745
- Said microbes spontaneously generated
- Evidence
 - Heated chicken soup
 - poured into flasks
 - covered flasks
 - microbes appeared

Problems with experimental design??

Lazzaro Spallanzani

- Italian Monk 1765
- Said Needham's broths contaminated after heating
- **Evidence**
 - chicken soup poured into flasks
 - covered flasks
 - then heated soup
 - **microbes DID NOT appear**

Spontaneous Generation

“ Production without parent of a new living organism” (Pouchet 1859)

■ Required

- a solid organic substance just after death
- air containing “Life Force”
- water

Frankenstein??

Biogenesis

- Concept proposed by Rudof Virchow
 - German Scientist 1858
- Virchow had No Evidence

Biogenesis or cell theory: cells can only arise from preexisting cells

Biogenesis

Omne vivum ex vivo

Harvey

The Cell Theory

- All organisms composed of one or more cells
- Cells are smallest living things
- Cells arise only from previously existing cells
- **Thus: all organisms are descendents of the first cells**

Schwann Experiment

- Broth heated in flask
- Air heated
- Air and broth mixed
- No Growth

Pouchet argued that “Life Force” destroyed

Academy of Sciences 1860

Award for a solution

And the Winner is..??

- Louis Pasteur
- Confirmed experiments of Redi & Schwan
- Filtration Experiments
 - air filtered through guncotton
 - dissolve guncotton
 - Examined residue
 - contained microbes and dust
- **Conclusion:** microbes in the dust not in air



Final Proof

Swan Neck Flask Experiment

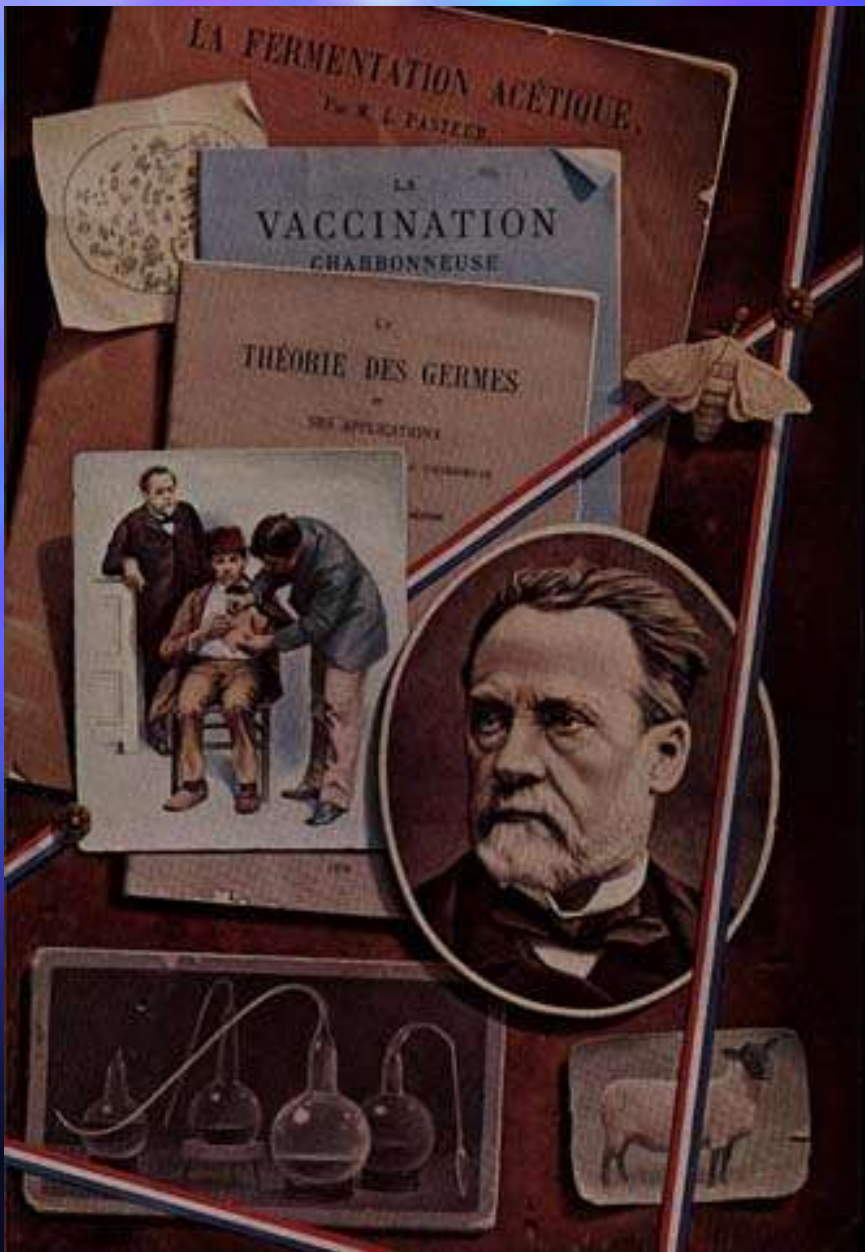
- Add broth to flask
- Bend the neck of the flask(air can enter but dust cannot)
- Heat broth
- No bacterial growth
- Break neck of flask
 - dust enters
 - Growth occurs

Altitude Measurements

- Arbois (sea level) 8/20 flasks contaminated
- Jara (850 meters) 5/20 flask contaminated
- Mer de Glace (2,000 meters) 1/20

Louis Pasteur

- Added 20 years to the lifespan of every man woman and child
- improved the quality of life



Golden Age of Microbiology

- Fermentation
- Pasteurization
- Disinfection
- Vaccines

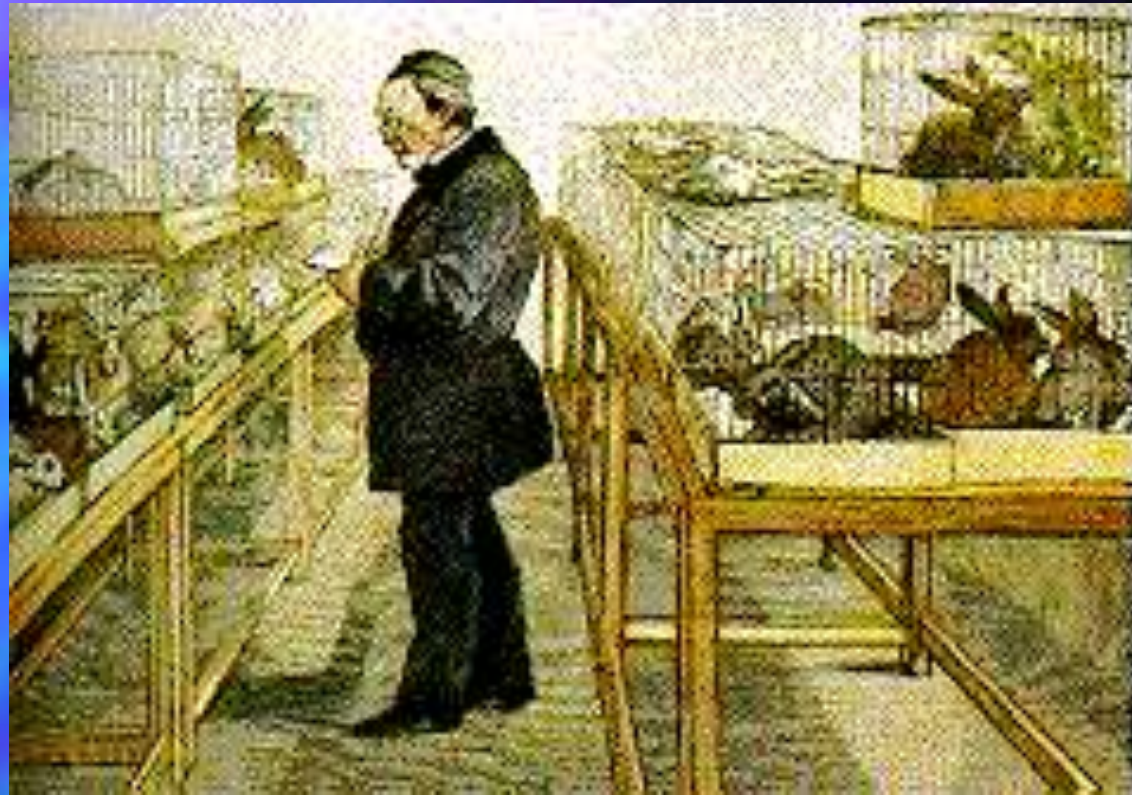


French wine was spoiled during shipment



Louis Pasteur

- Germ theory
- Fermentation
- Pasteurization
- Rabies vaccine
- *Streptococcus pneumoniae* causes lobar pneumonia

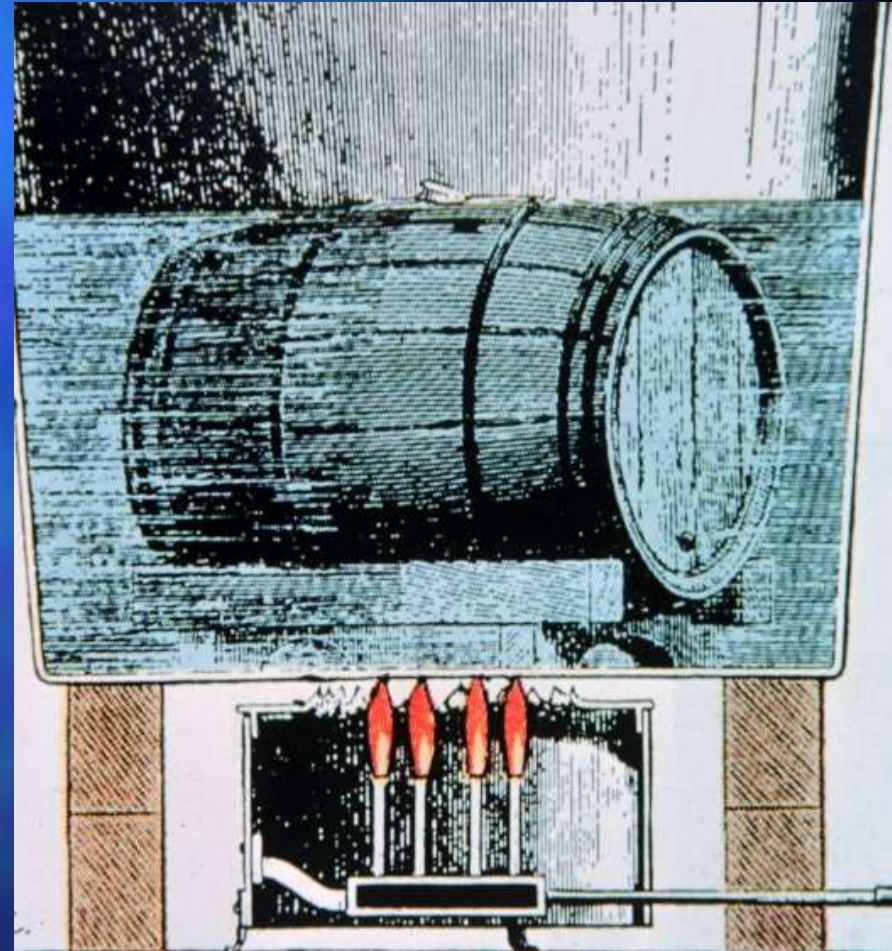


Fermentation

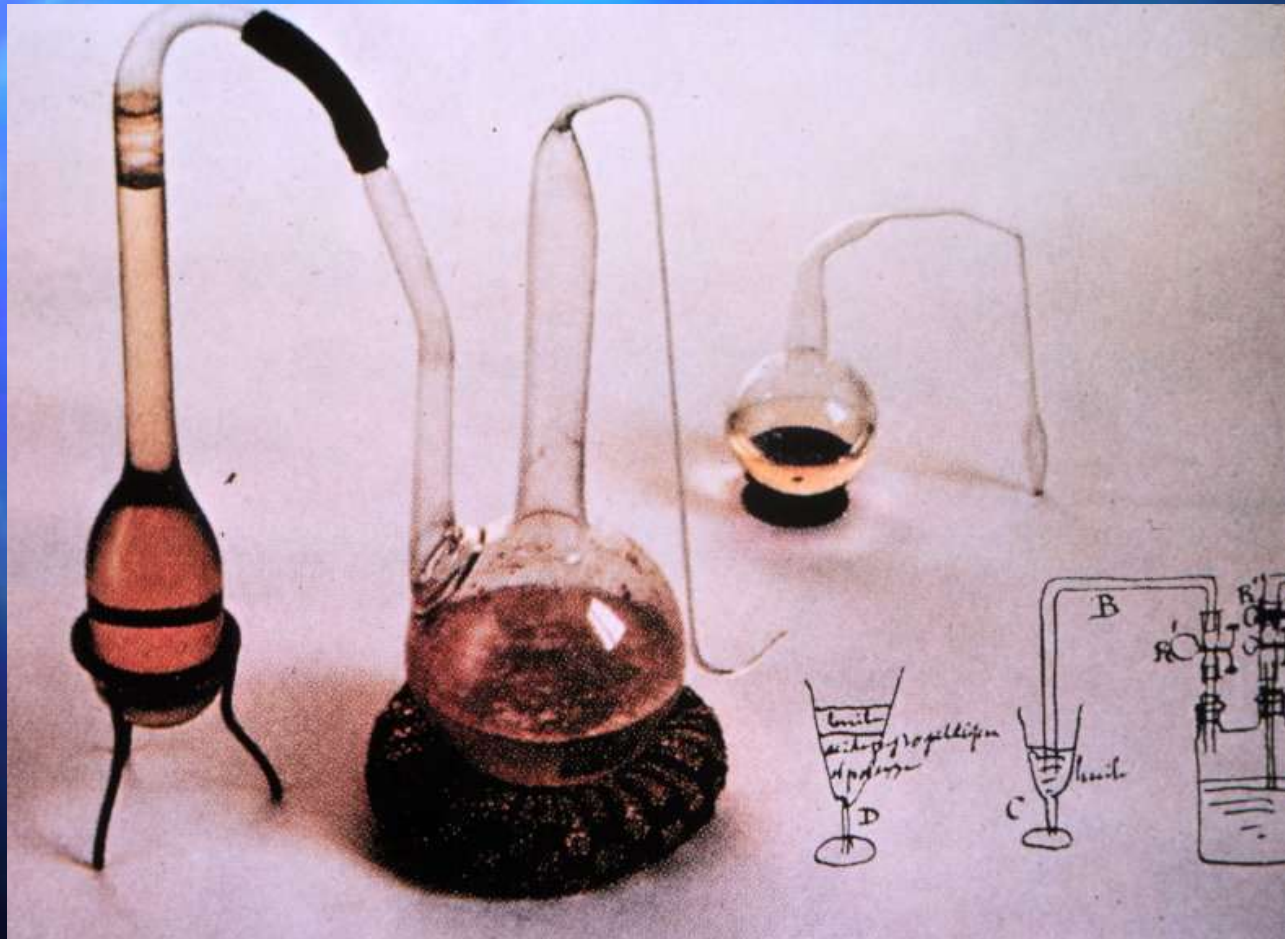
- Vintners thought sugar **chemically** converted to alcohol in air
- Pasteur, a chemist, was asked to help
- Discovered
 - Yeast convert sugars to alcohol
 - Bacteria change alcohol to vinegar
- **Fermentation was biological process**

Pasteurization

- Pasteur connected food spoilage and microbes
- Pasteurization: Destroy microbes that cause spoilage by heat
 - Beer, wine, milk
- Critical to development of Germ theory



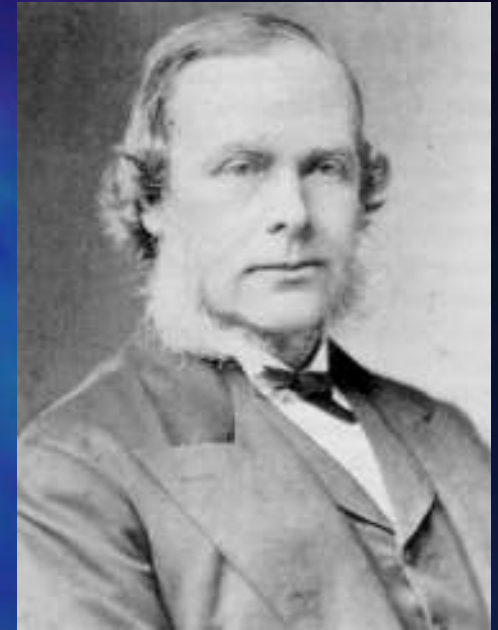
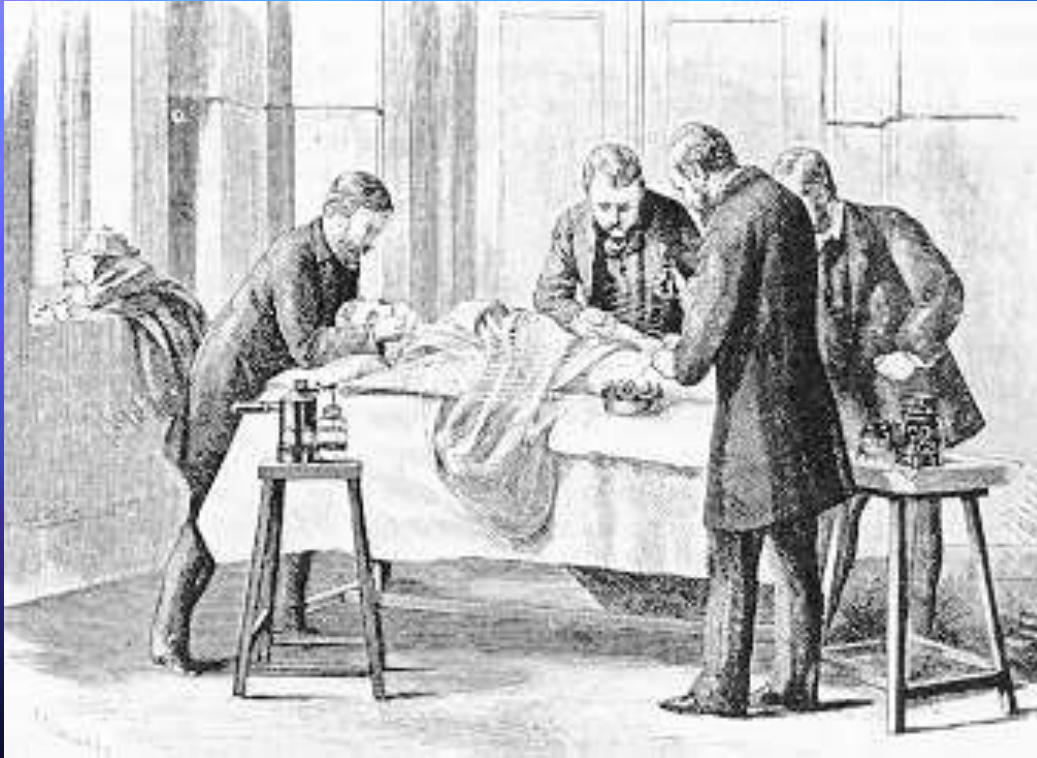
Pasteur's Original Flasks



Germ Theory of Disease

- Causal relationship between microbes and disease
- Disinfection controls surgical infection
- Microbes cause disease

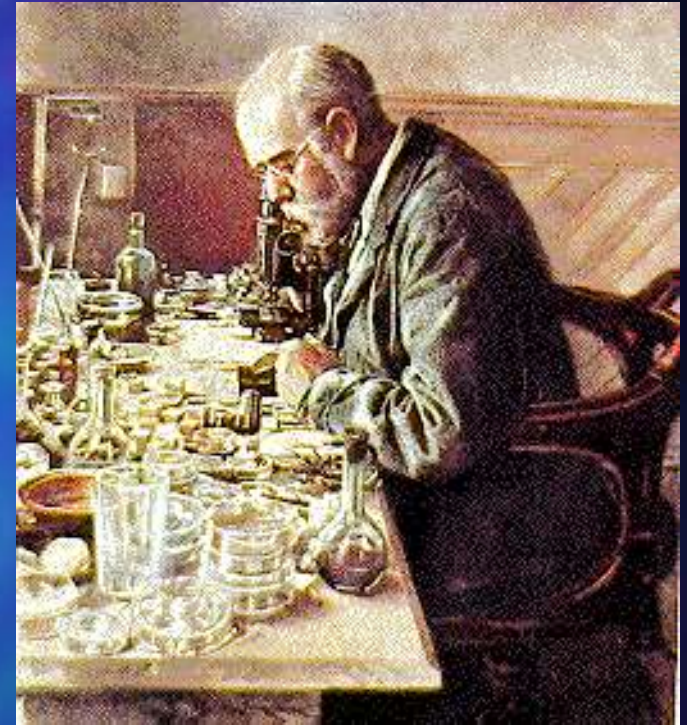
Joseph Lister



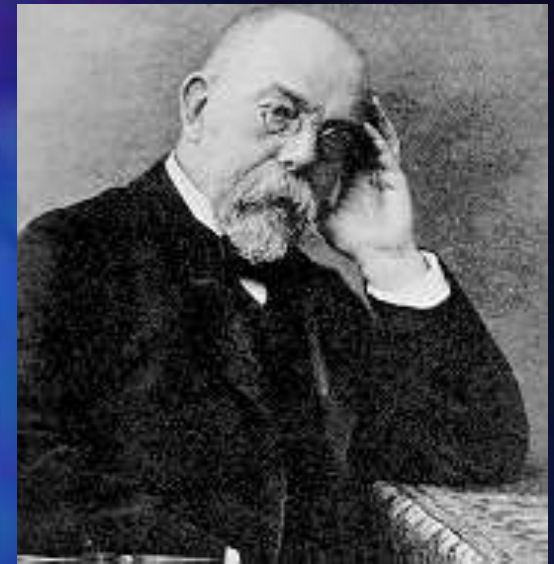
Developed antiseptic surgery

Robert Koch

- Confirmed germ theory
- Discovered cause of
 - anthrax
 - cholera
 - tuberculosis
- Developed
 - pure culture techniques
 - staining techniques
 - solid media



Koch's postulates



Rules to prove an organism causes a disease

- Organism consistently isolated from diseased individuals
- Organism cultivated in pure form
- Signs and symptoms induced after inoculation
- Same organism isolated from experimentally infected individual

Vaccines

Smallpox

- isolated smallpox virus from pustules on Egyptian mummies
- Father of Amhetop



Pustules Caused by Pox Virus



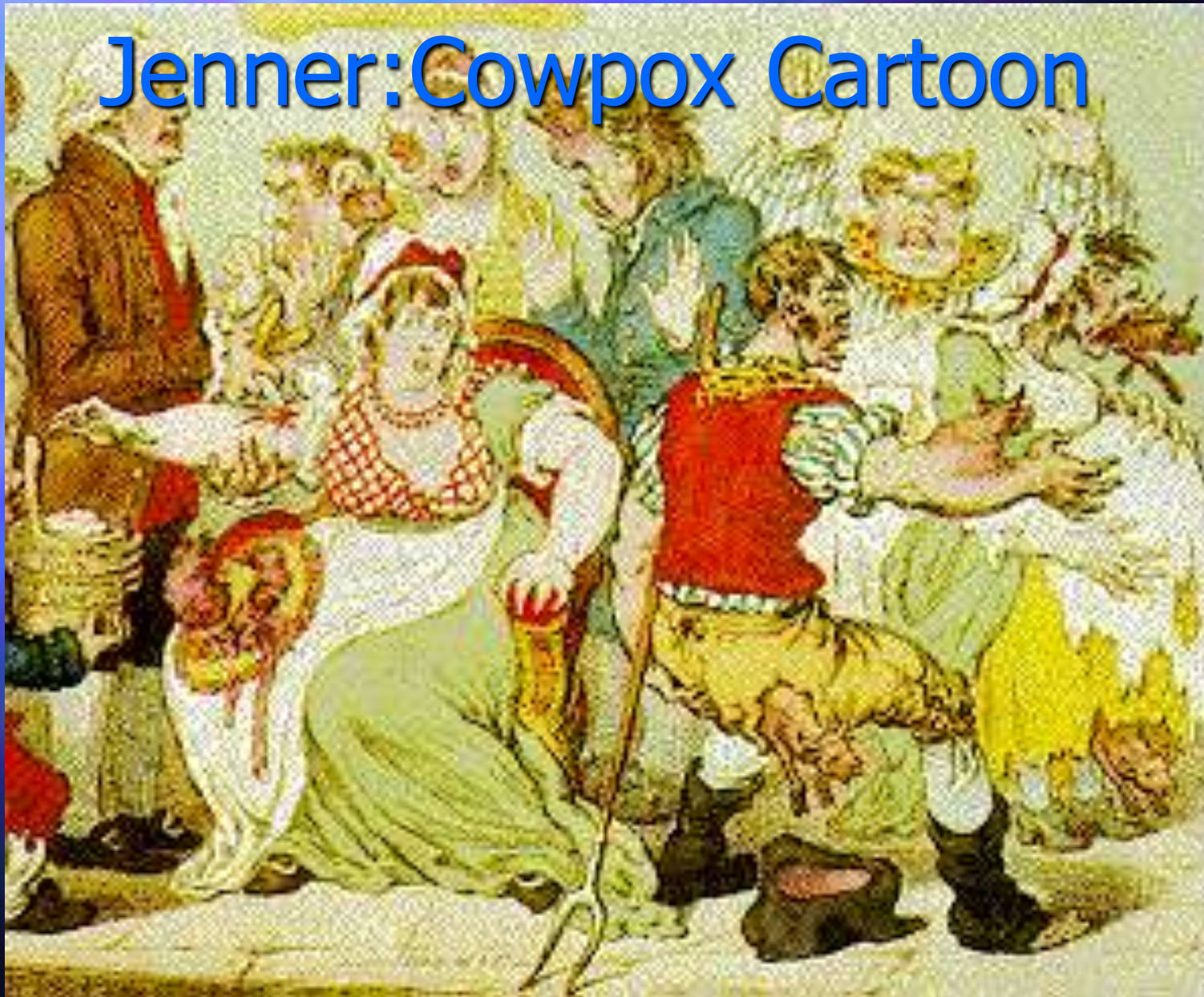
Edward Jenner

Edward Jenner



Vaccination
for smallpox

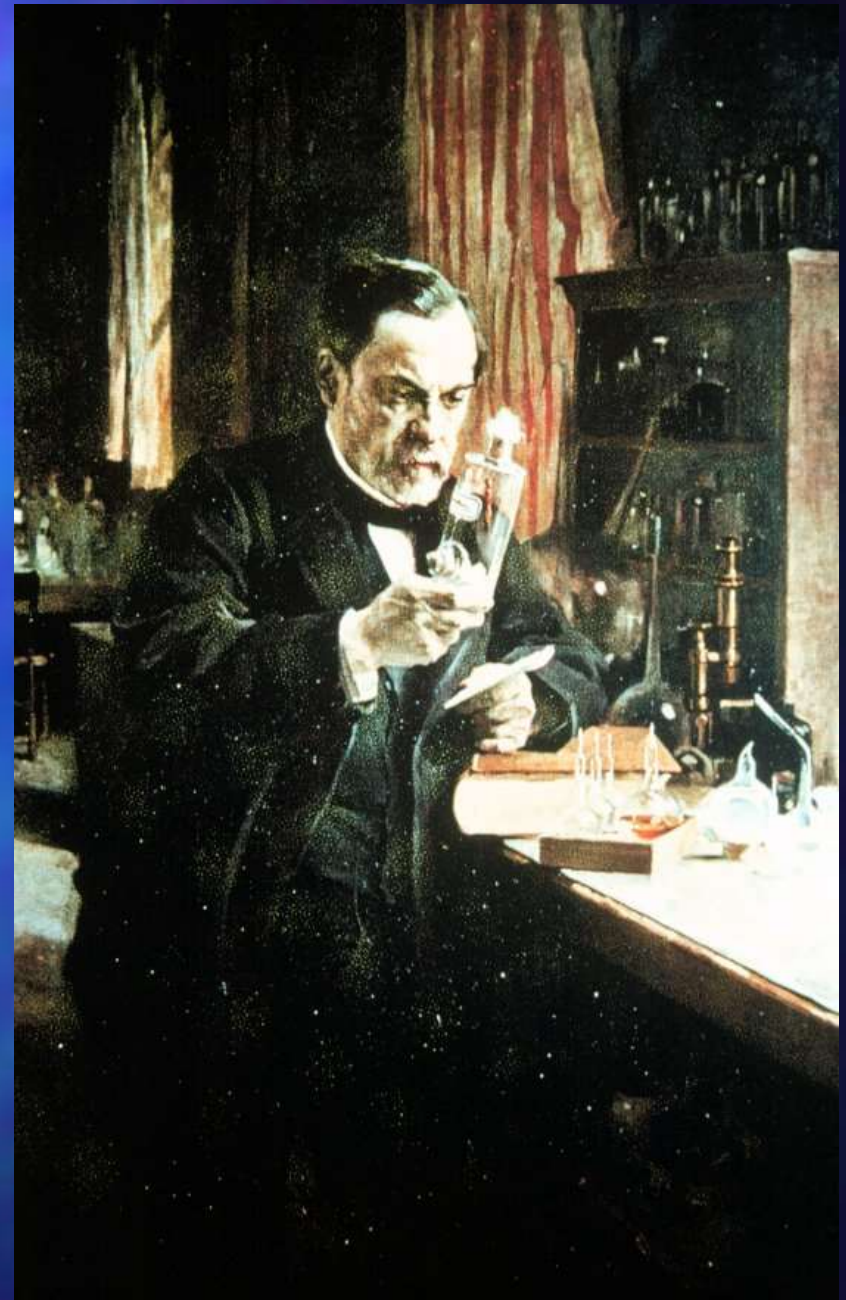
Jenner: Cowpox Cartoon



Punch ? 1802

Rabies vaccine

- Pasteur described a rational basis for the development of vaccines



Vaccie was unethical !!

