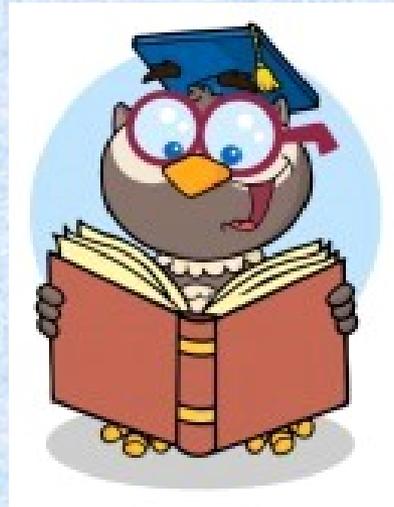


The History of Biomedical Science

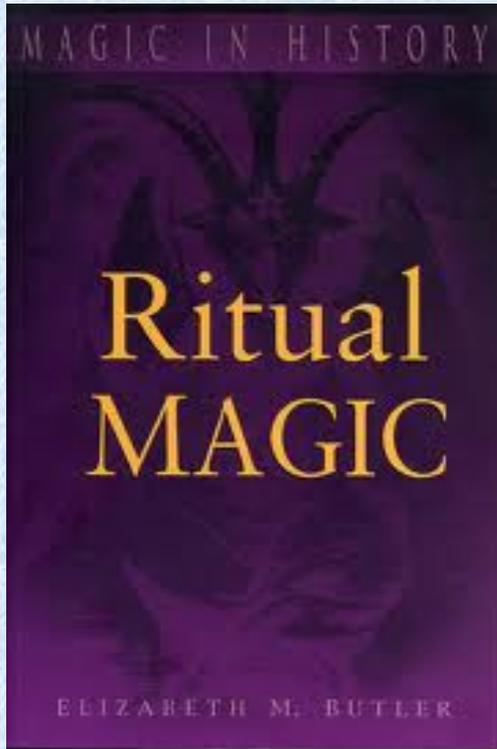


Turning the accomplishments of many
years into an hourglass

Three Phases of Biomedical Research

- 1. An *early phase* based on ritual and magic.**
- 2. A *rational phase* based on the creative imagination.**
- 3. A *modern phase* based on experimental design and laboratory investigation.**

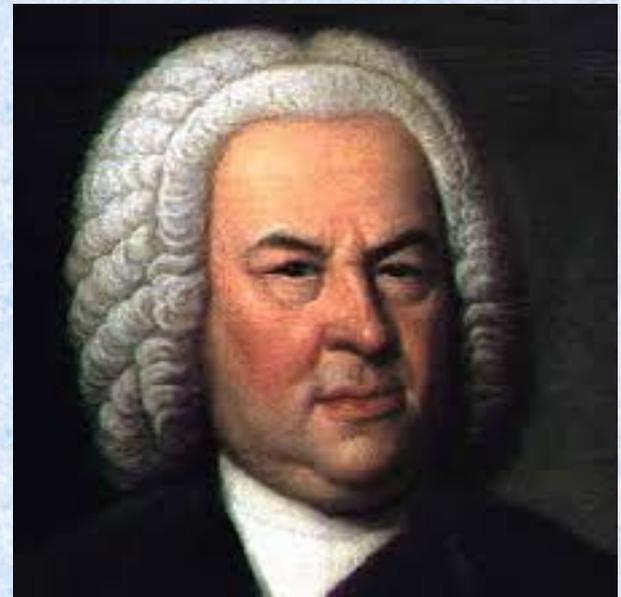
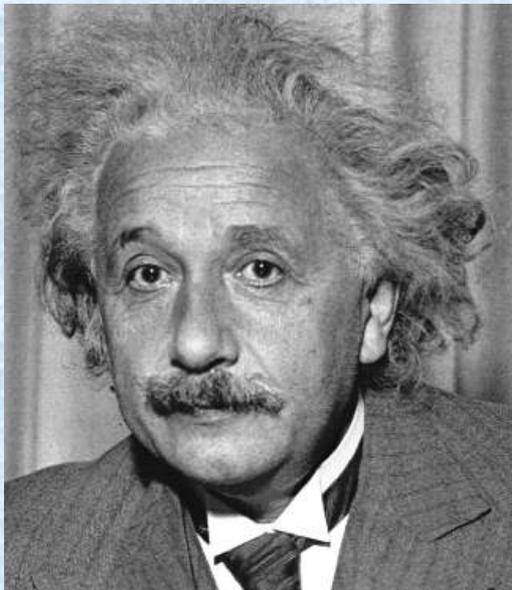
Ritual & Magic

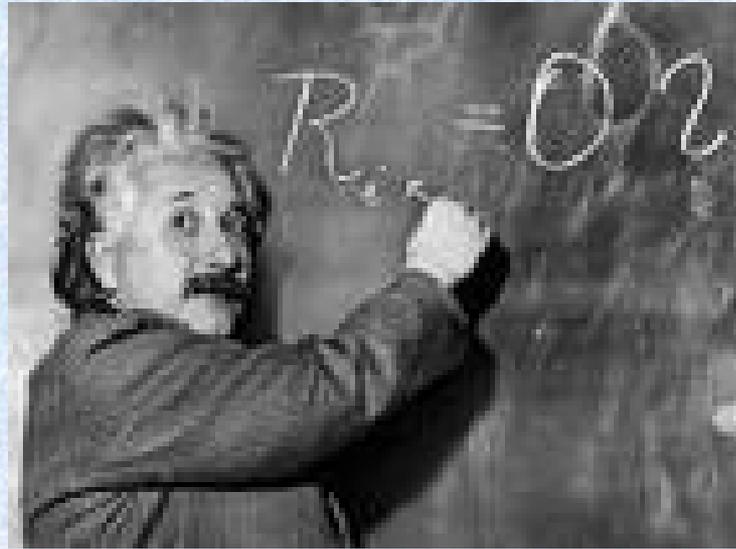


Magic deals with supernatural manipulation of reality through the occult. In contrast to religion and prayer, magic is concerned with immediate results.

Creative Imagination

Without the scientific genius of Einstein, we would still have relativity, but without the creative imagination of Bach, we would not have the B Minor Mass





Smart folks are a dime a dozen. What matters is imagination and creativity.

Remember to Think

A man will be imprisoned in a room with an unlocked door that opens inwards as long as it does not occur to him to *pull* rather than push.



Ludwig Wittgenstein

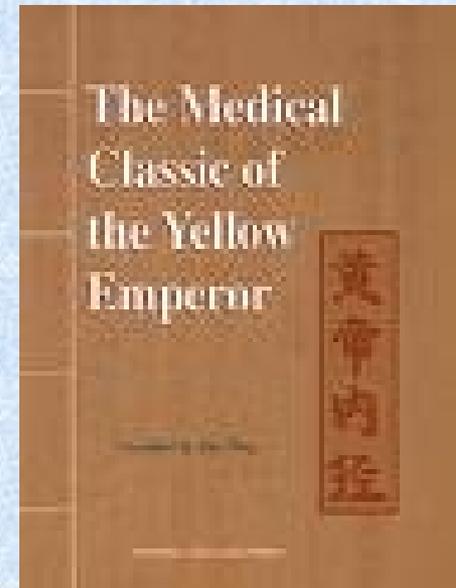
Experimental Design and Laboratory Investigation



The Yellow Emperor's Book of Medicine

Traditional Chinese Medicine.

First Century BC



Two Thousand BC

4000 years before William Harvey, the Chinese discovered that the heart was a pump that circulated blood round the body and accounted for the pulse.

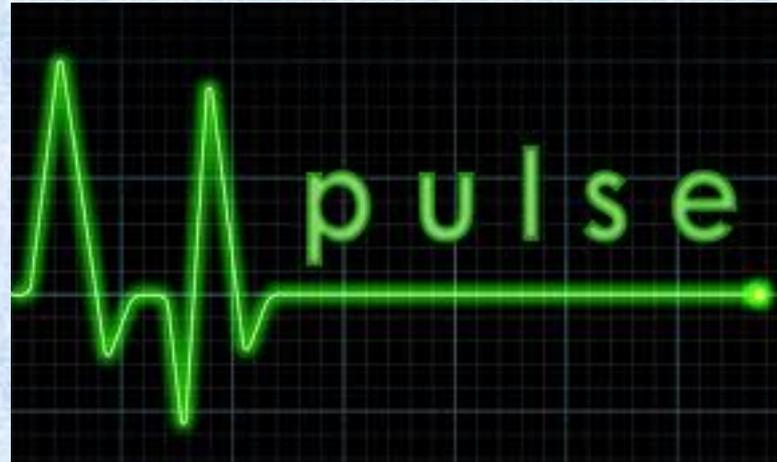


For male patient, feel
left hand pulse first



25. For female patient,
feel the right hand pulse
first

The Yellow Emperor's Comment



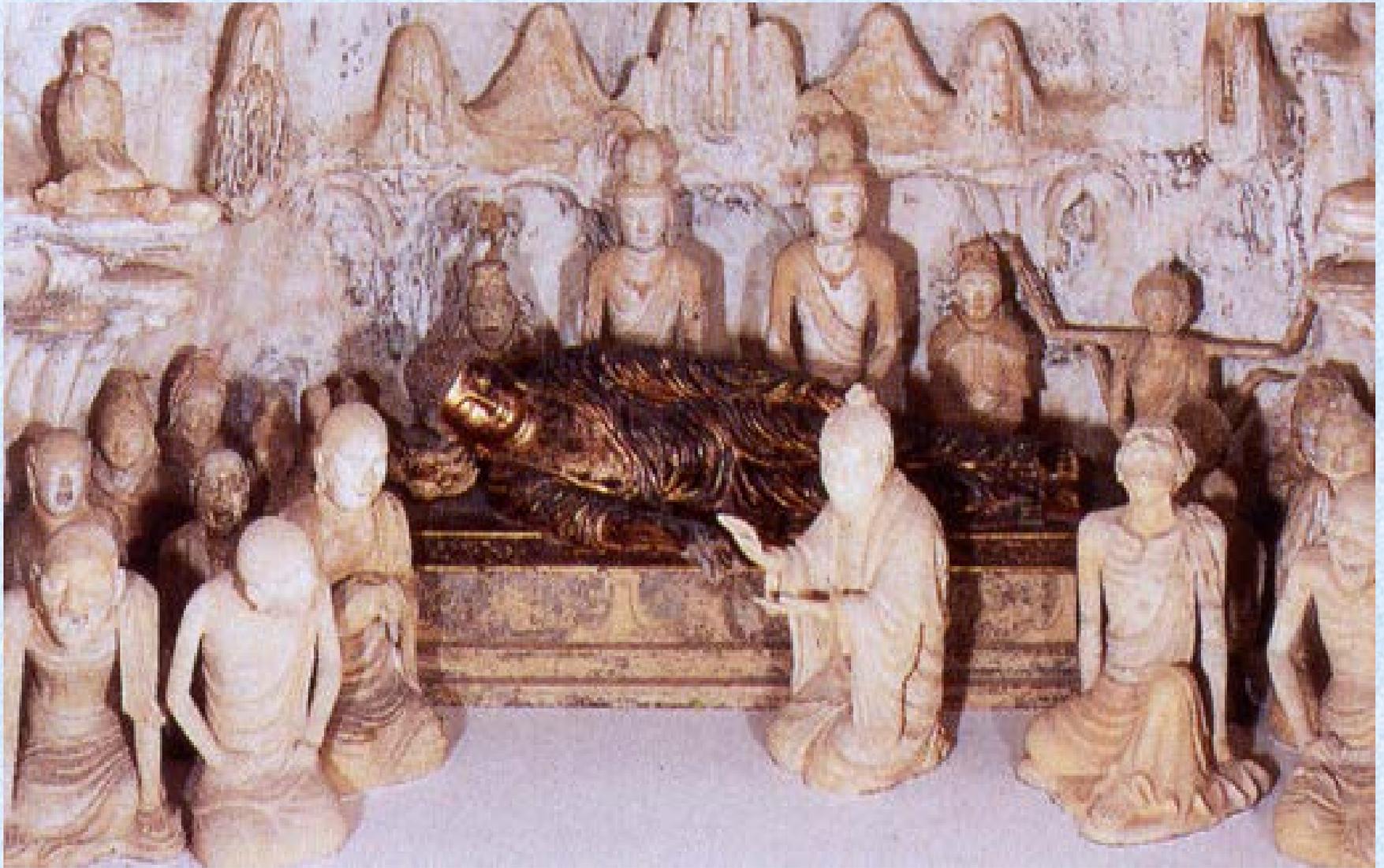
"Nothing surpasses the examination of the pulse. One must distinguish a gentle pulse of low tension from a hard or bounding pulse. The heart influences the force of the pulse, and fills the pulse with blood."

Historical



Contemporary





Death of the Buddha 544 BC

Symbol and Metaphor



For 5,000 years, the heart was regarded as a symbol and metaphor, the seat of our deepest emotions, a subject of art, music, poetry and hieratic texts, the icon of love, joy, and grief.

Primitive Conceptions of Disease



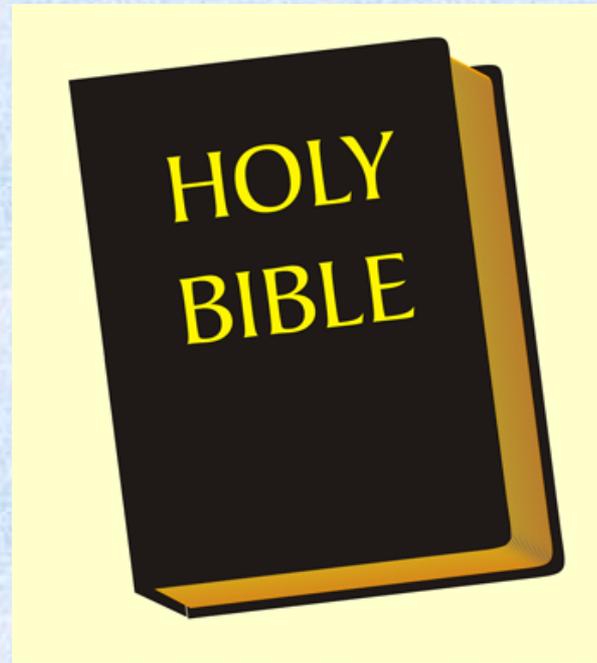
Disease was believed to be a struggle between the benevolent spirit of health and animistic forces of evil that entered the body and overpowered the soul.

33rd Century BC



Ancient Egypt is among the oldest sources of medicine. From the 33rd century BC until the Persian invasion of 525 BC, Egyptian medicine remained largely unchanged, and was highly advanced for its time, including minor surgery, setting of bones, and an extensive pharmacopoeia.

The Genesis of Anesthesia was Genesis



And the Lord God caused a deep sleep to fall upon Adam, and he slept: and He took one of his ribs, and closed up the flesh thereof.

Seventeenth Century

Opium and the Advent of Anesthesia

Thomas Sydenham (1624-1689)



Among the remedies which it has pleased Almighty God to give to man to relieve his sufferings, none is so universal and so efficacious as opium.

Seventeenth Century

The Scourge of Tobacco

James I, King of
England (1604)

A custom loathsome to
the eye, hateful to the
nose, harmful to the
brain & dangerous to
the lungs.



*21st Century
Equality for Women*

Equal cancer

Equal emphysema

Equal heart disease



Courtesy, Virginia Slims

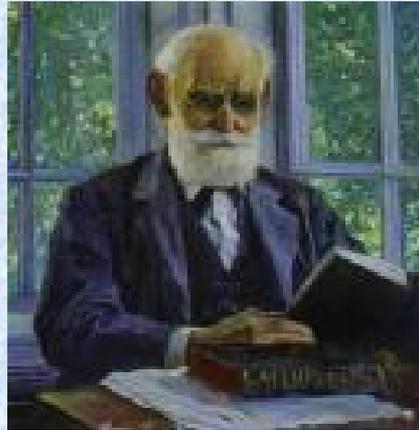
Eighteenth Century
The Birth of a Nation



Twenty First Century
The Girth of a Nation



Twentieth Century
Ivan Petrovitch Pavlov
Nobel Prize in Physiology or Medicine
1904



Today, Pavlov would not have gotten Institutional Review Board approval for his work on the physiology of digestion.

A Needed Clinical Trial

Brit Med J 2003

Objective: To determine whether parachutes are effective in preventing trauma related to gravitational challenge.



Parachutes are widely used to prevent death and major injury from gravitational challenge, but their effectiveness in doing so has not been subjected to a multicenter, double blind, randomized, placebo-controlled, crossover trial.

18th/19th Centuries

Auenbrugger's discovery of percussion
and *Laennec's* discovery of the stethoscope
advanced diagnostic medicine
beyond anything imagined.



Percussion

Leopold Auenbrugger

1761 *Inventum Novum
Thoracis Humani*



Wine Casks

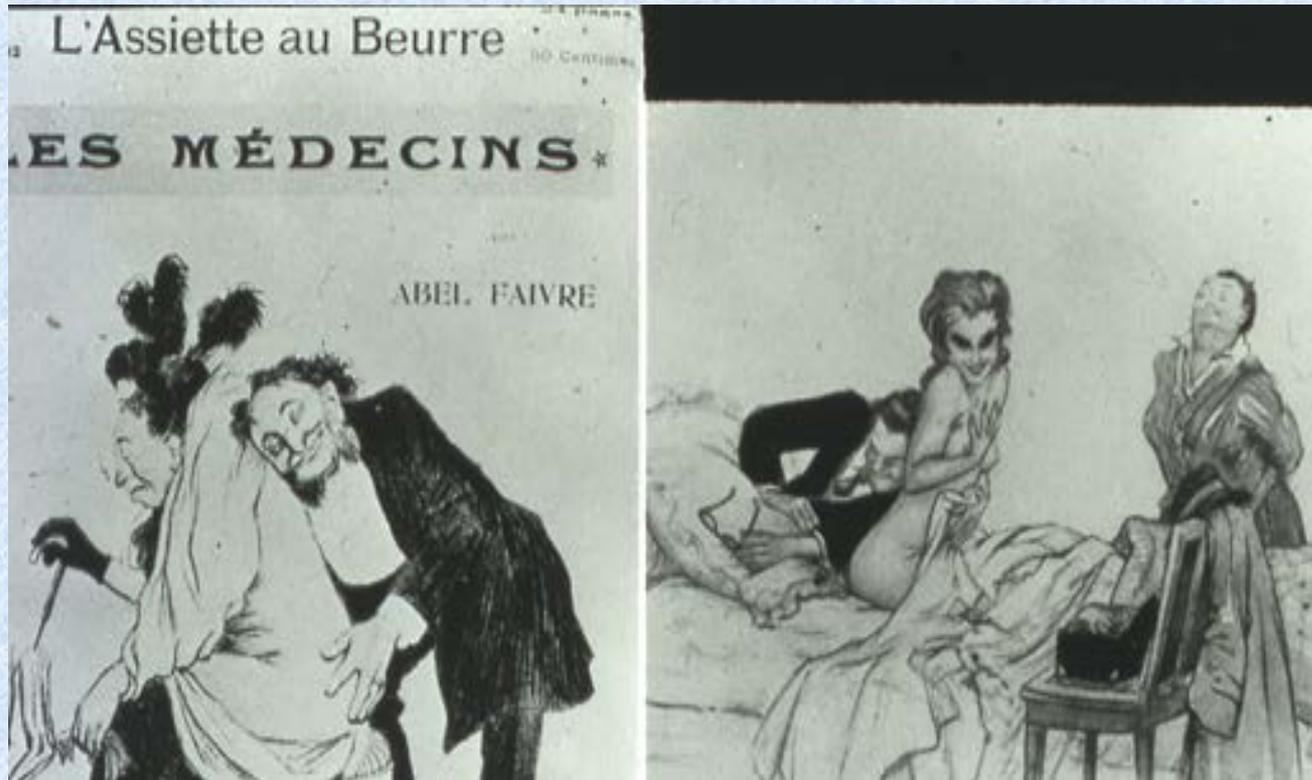


Auenbrugger

I here present the reader with a new sign which I have discovered for detecting diseases of the chest. This consists in percussion of the human thorax, whereby, according to the character of the particular sounds thence elicited, an opinion is formed of the internal state of that cavity.

Auscultation

A French Perspective



Nineteenth Century



Rene Theophile Hyacinthe Laennec



Eighteenth Century

Sir Isaac Newton



In a Single Year

The spectrum of colors

The binomial theorem

Differential and integral calculus

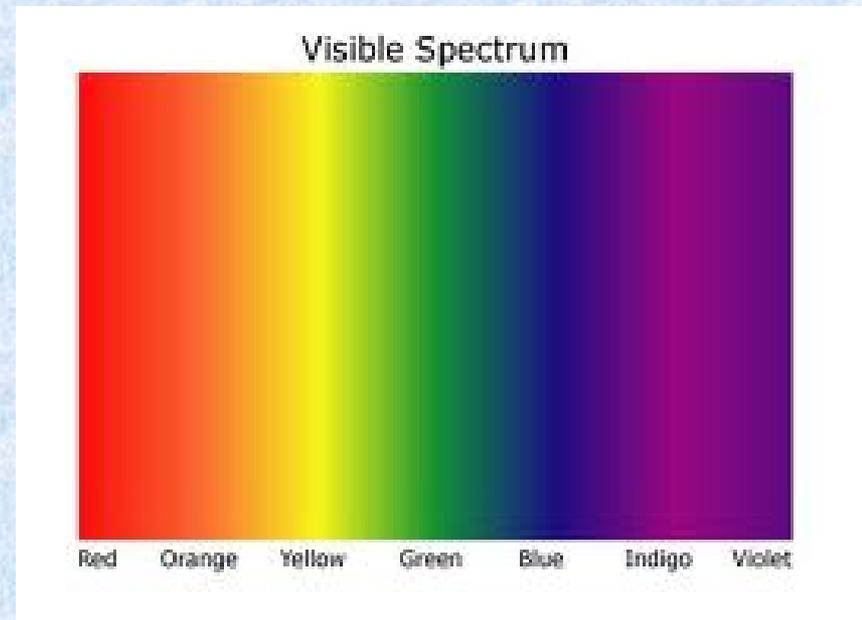
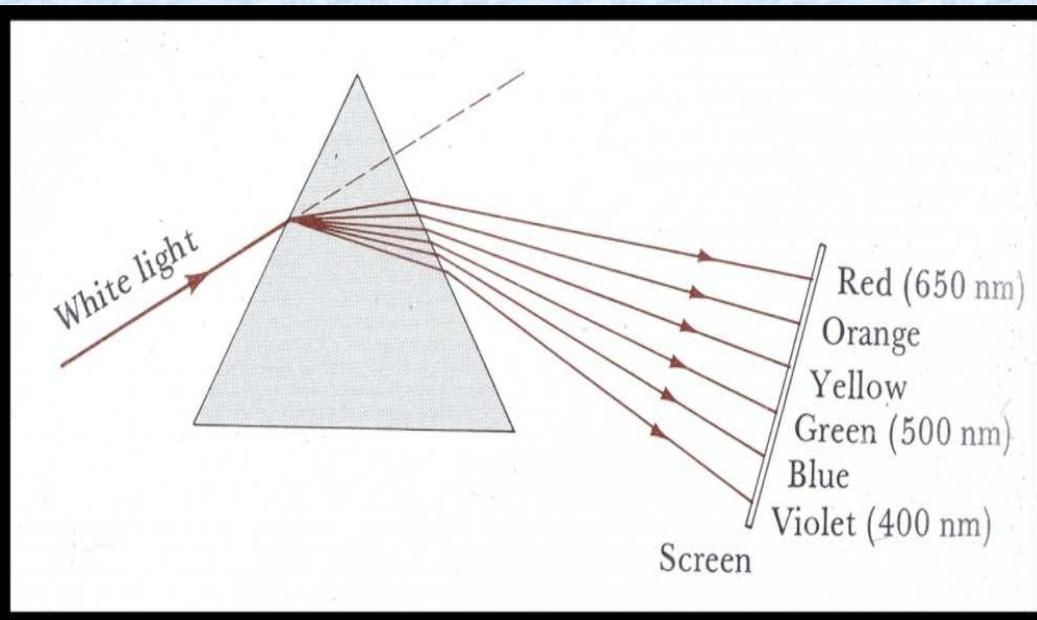
The theory of gravitation

The Color Spectrum

One bright sunny day in 1665, Isaac Newton, a young scientist at Cambridge, darkened his room and made a hole in the window shutter, allowing a single beam of sunlight to enter. He then took a glass prism and placed it in the sunbeam. The result was a spectacular multicolored band of light just like a rainbow.

Physical Optics

Newton's Color Spectrum



18th/19th Century



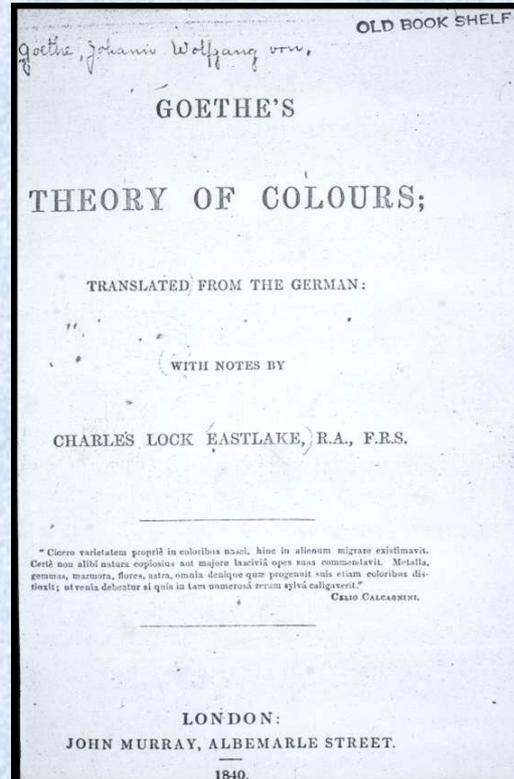
Johann Wolfgang von Goethe (1749-1832), the greatest poet, playwright, and novelist in the German language, wanted to be remembered as a scientist.

Goethe's Color Theory

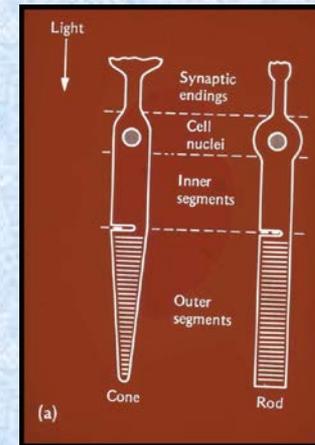
How Color is Perceived

There Are No Colors in Nature

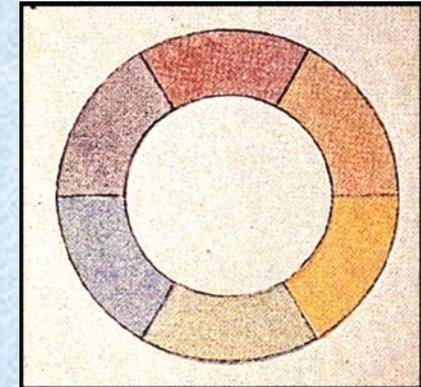
1810



Goethe Misused Newton's Prism



Rods & Cones
Photoreceptors



Color Wheel
Primary, secondary &
complementary colors

THE
METAMORPHOSIS
OF PLANTS

JOHANN WOLFGANG VON GOETHE



INTRODUCTION AND PHOTOGRAPHY
BY GORDON L. MILLER

In his seminal essay, *Metamorphosis of Plants* (1790), Goethe described the calyx, the corolla, the pistil, the stamen, the cotyledons, the photosynthetic leaves and the petals.

The Second Scientific Revolution

Late 18th Century

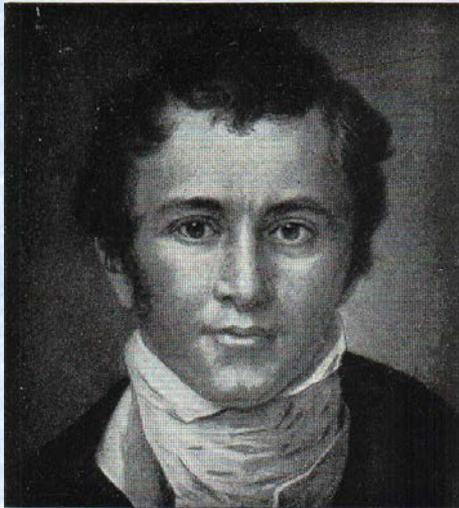


In 1783, a craze swept across Europe. The Montgolfier brothers sent over the rooftops of Versailles a balloon held aloft by nothing more than *a cloud in a paper bag*.

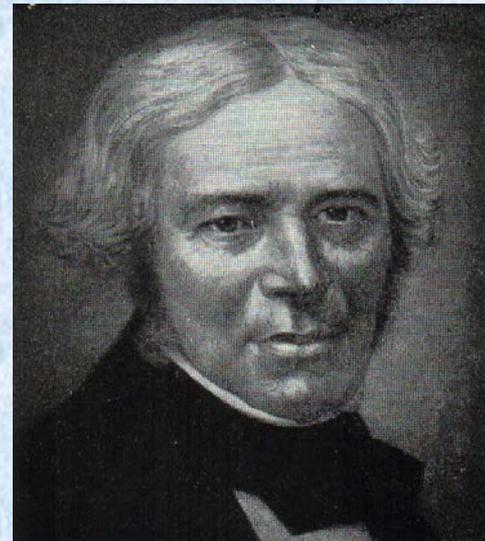
British scientists brought a new imaginative intensity to scientific work with discoveries that rivaled those of Newton and Galileo.

Nineteenth Century

In 1809, *Humphrey Davy* invented the electric light,
In 1848 *Michael Faraday* discovered that an electrical current heats a wire through it passes, providing warmth from electrical power.



Humphrey Davy

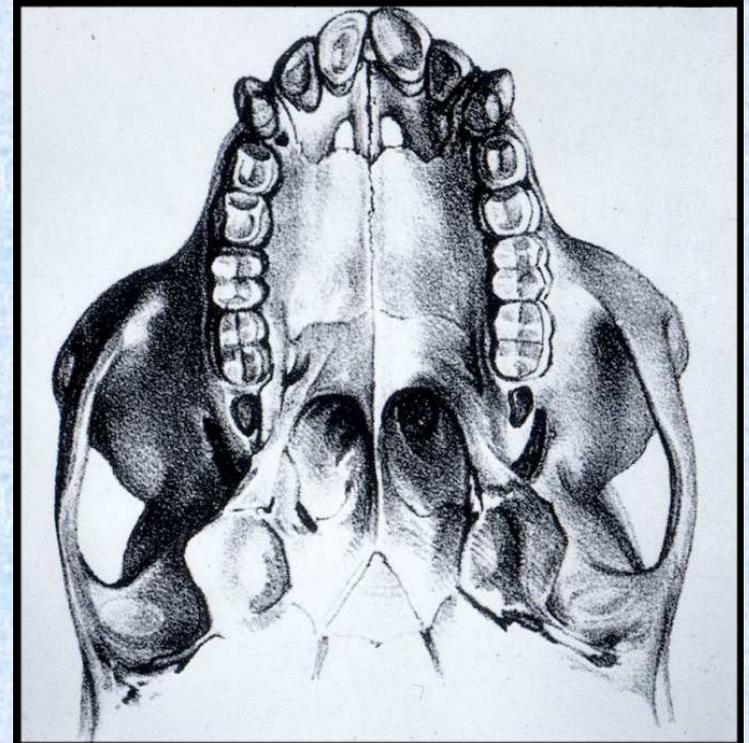
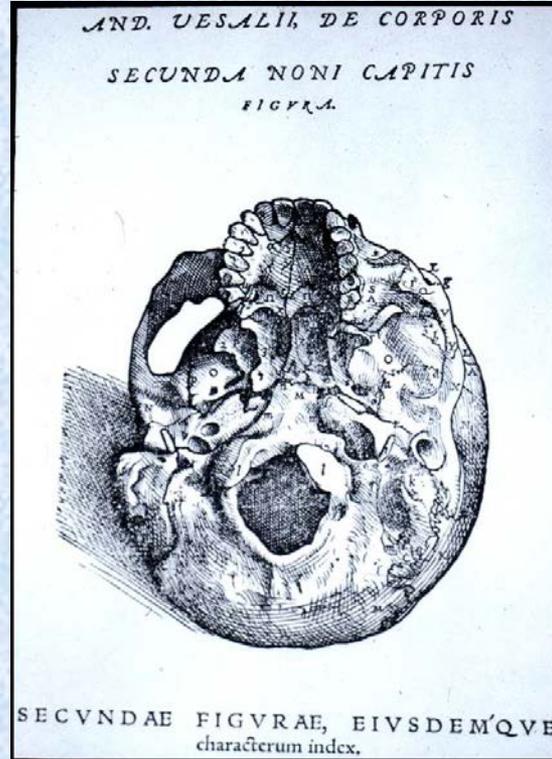
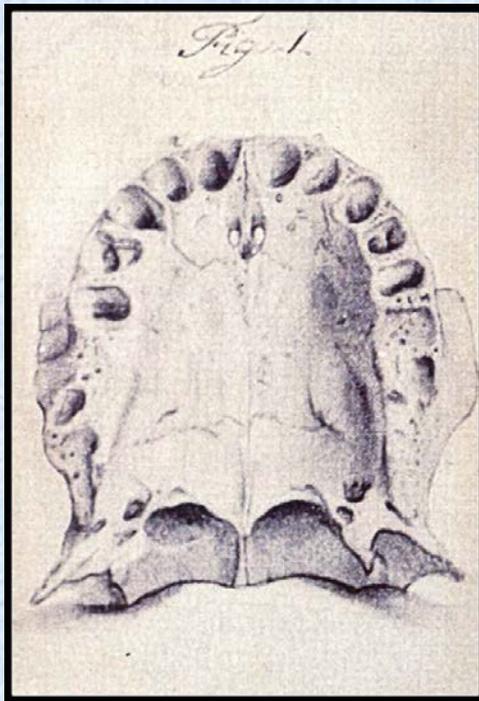


Michael Faraday

A Prelude to Darwinian Evolution

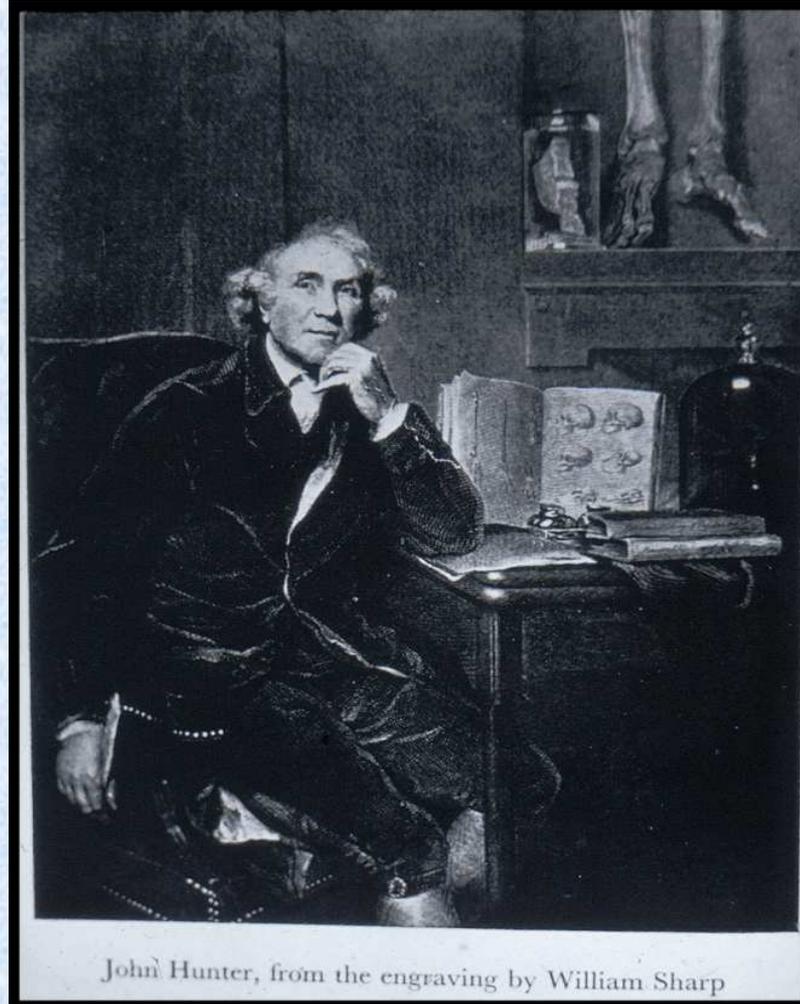
Goethe's Comparative Anatomy

The Intermaxillary Bone



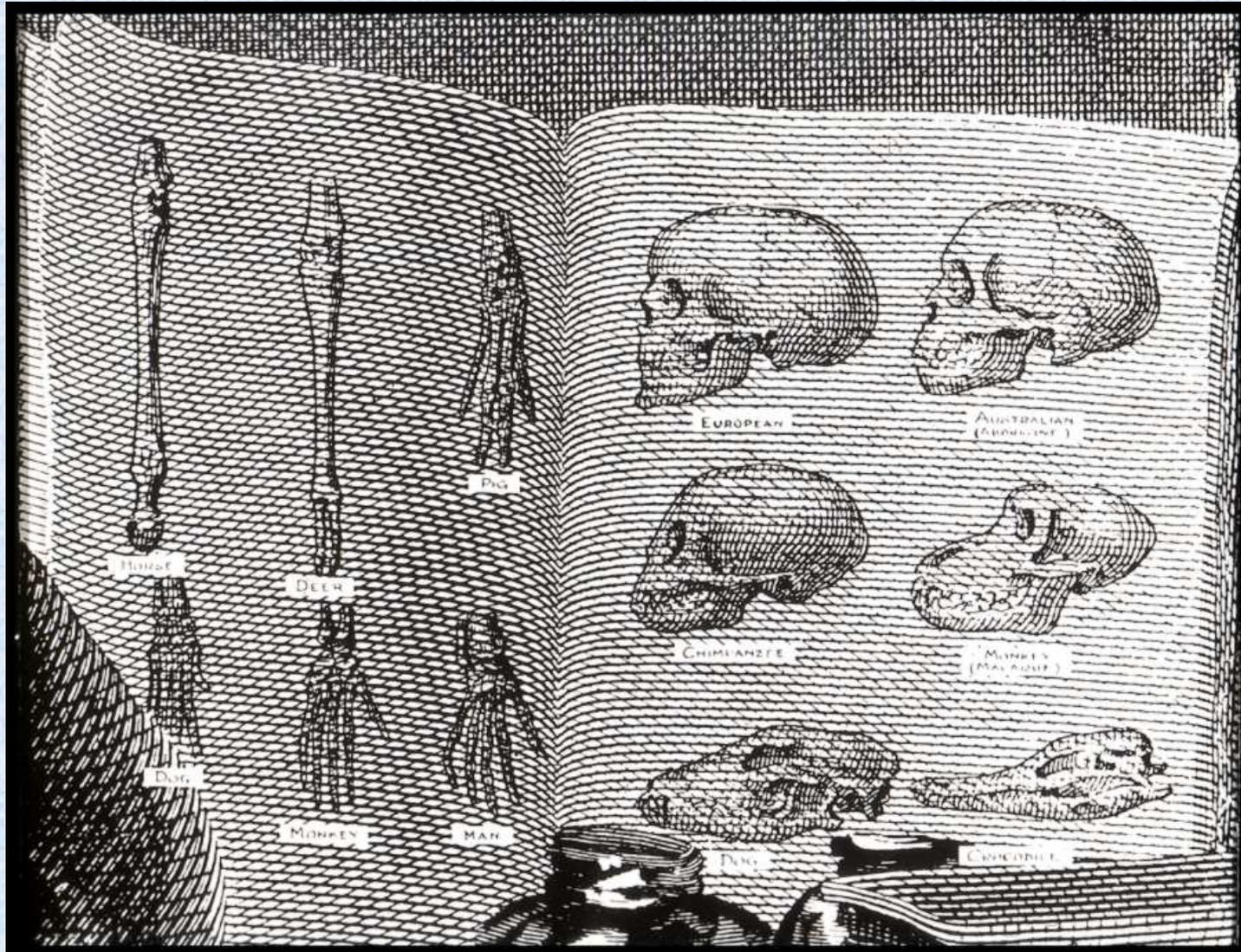
A Prelude to Darwinian Evolution.

John Hunter



John Hunter, from the engraving by William Sharp

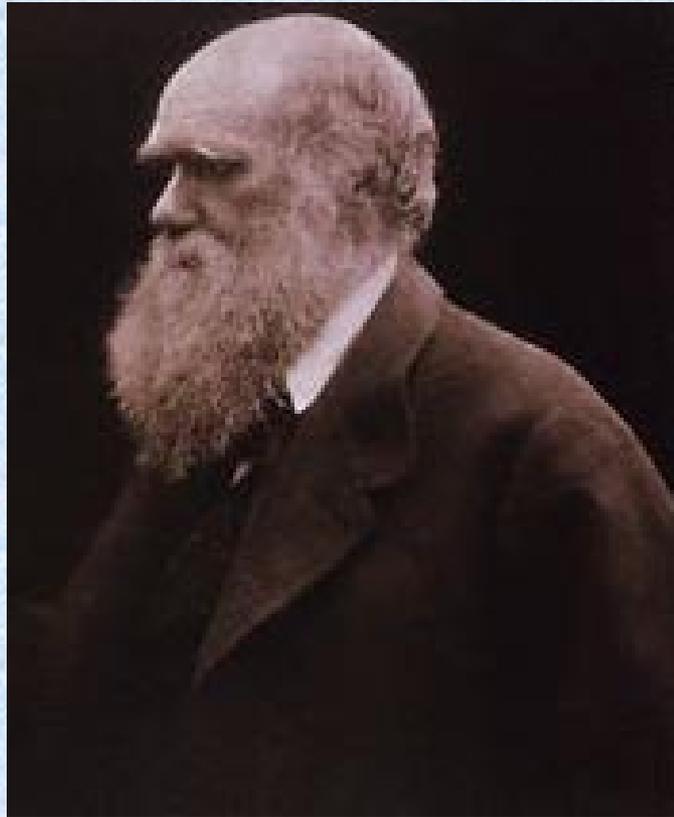
Hunter's Comparative Anatomy

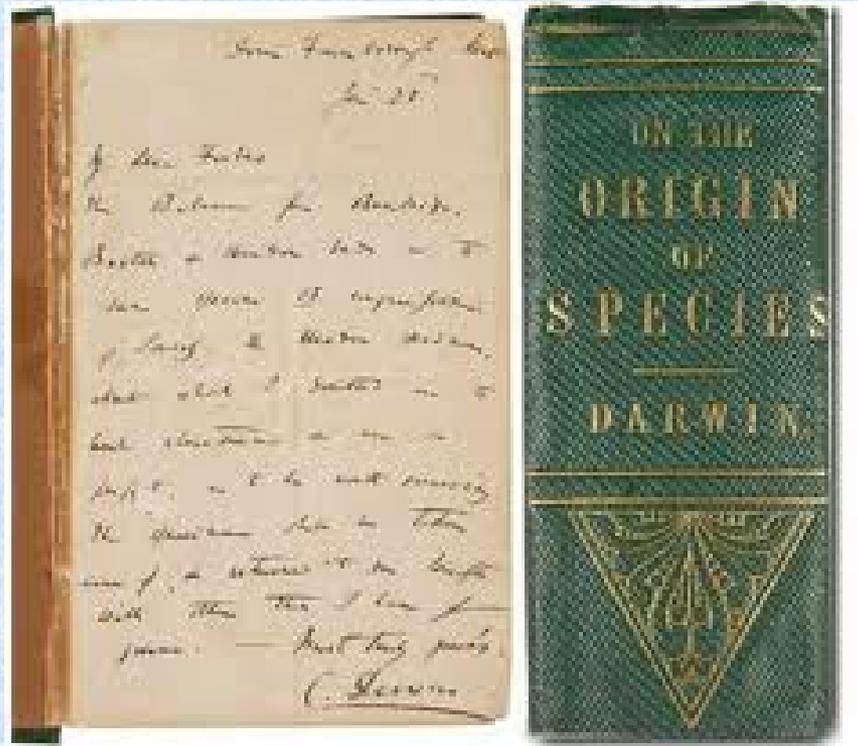


The Nineteenth Century

Charles Darwin

1809-1882

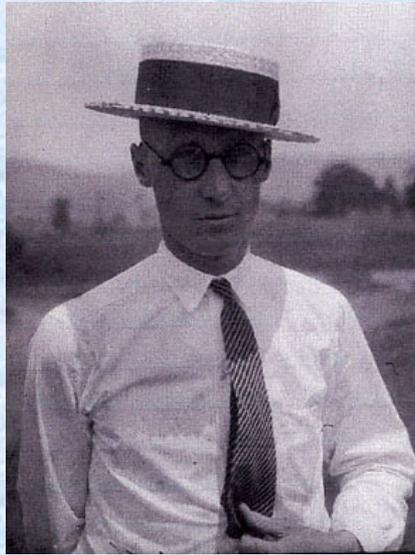




On The Origin of the Species (1859) was among the most influential books ever published, a scientific and philosophical landmark that challenged beliefs in divine providence. The cultural climate was not receptive. Theologians decried Darwin as an apostate.

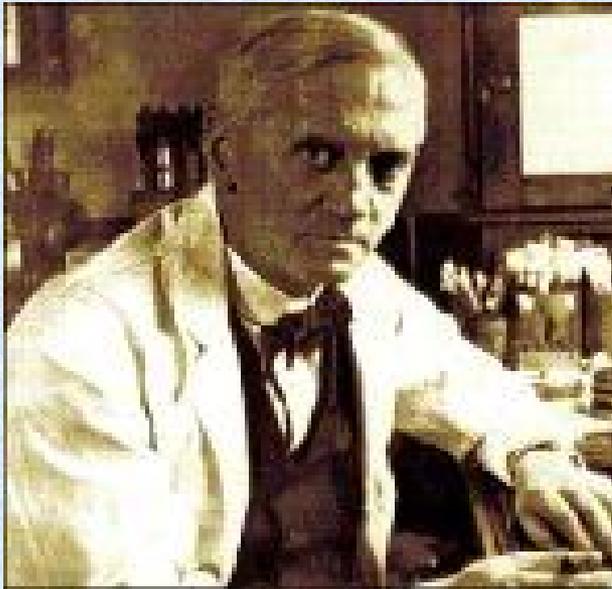
The State vs John Scopes 1925
The Monkey Trial in Dayton Tennessee

The light flickered and almost failed.

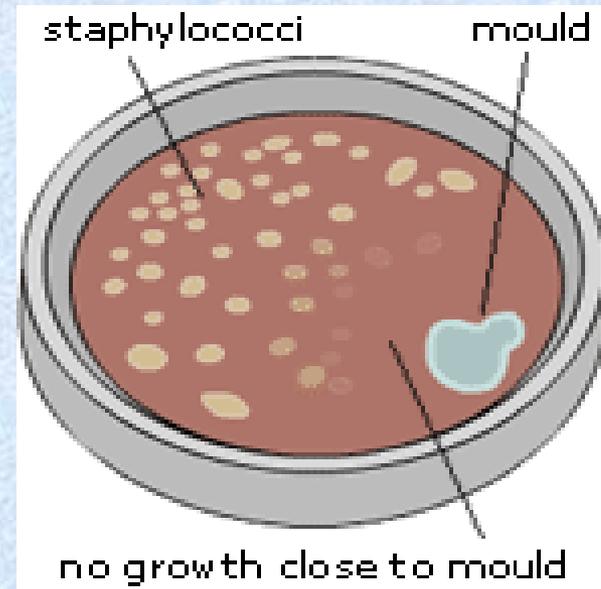


John Scopes, a high school teacher, challenged Tennessee's anti-evolution law. Opponents self-righteously marched down the streets singing *Onward Christian Soldiers*.

Discovery of Penicillin
The Magic Mold 1928
Alexander Fleming



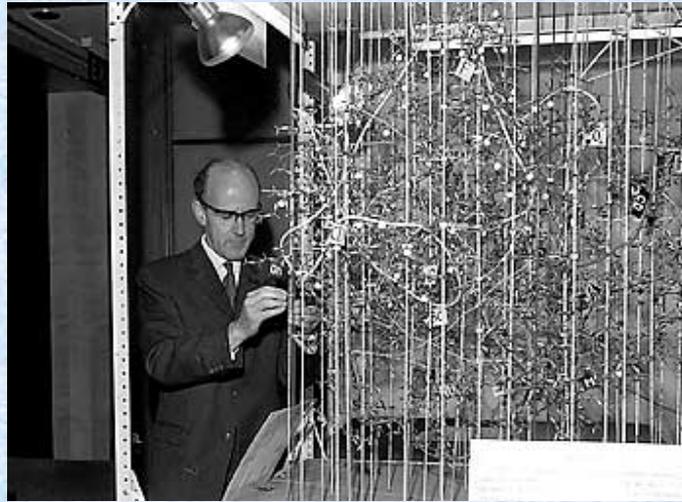
Fleming



Penicillium Notatum

1962 Nobel Prize in Chemistry

Max Ferdinand Perutz, A Viennese refugee from the
Nazis



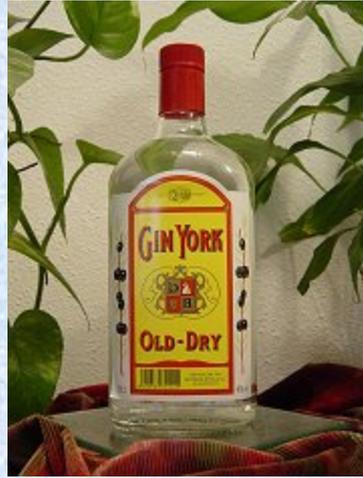
His Model of Hemoglobin.

Under Perutz, the Cambridge Laboratory of
Molecular Biology produced nine Nobel
Laureates.

Eighteenth Century England



Average life expectancy was 20 years.
The commonest causes of death were
gin, childbirth, smallpox and tuberculosis.



A Solace & A Curse

Until the Gin Act of 1751, alcohol was responsible
for 1 in 8 deaths in London.

There was a gin shop for every
120 citizens.

*Major Advances from
Unexpected Sources*

Lady Mary Wortely Montagu
wife of the British ambassador at
the court of the Ottoman Empire.

An English Country Doctor
Edward Jenner

SMALLPOX

The earliest skin lesions of smallpox appear on the faces of Egyptian mummies (1570-1085 BC)

The annual death toll from smallpox in 18th century Europe was 400,000.



20th Century Africa



Lady Mary Wortley Montagu

At the Ottoman Court



Innoculation

Small-pox, so fatal, and so general, is here entirely harmless. The local practice of deliberately stimulating a mild form of the disease through innoculation conferred immunity. Lady Mary had the procedure performed on both of her children.

THE SULTAN'S CHOICE



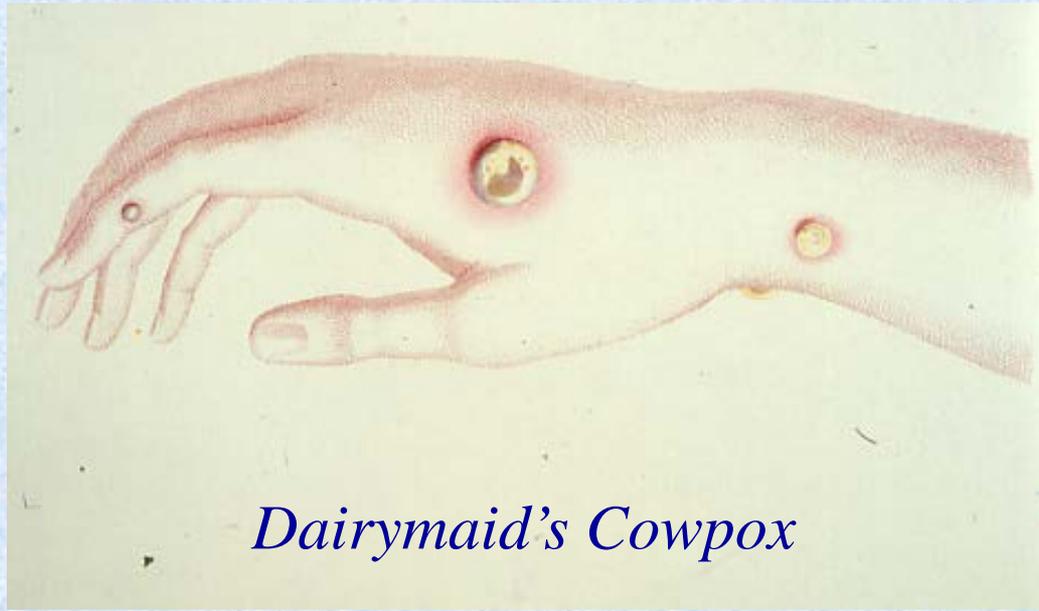
Women in the Turkish sultan's harem were inoculated as children in parts of their bodies where scars would not be seen.

Edward Jenner

An English Country Doctor



“... what renders the cow-pox virus so extremely singular, is that the person who has been thus affected is forever after secure from the infection of the smallpox; neither exposure to the viriolous effluvia, nor the insertion of the matter into the skin, producing this distemper.”



Dairymaid's Cowpox



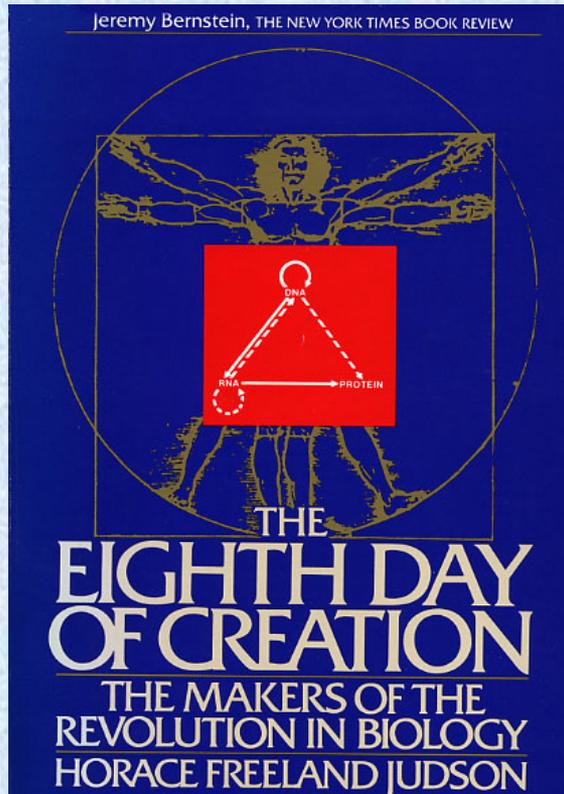
Jenner's Cowpox



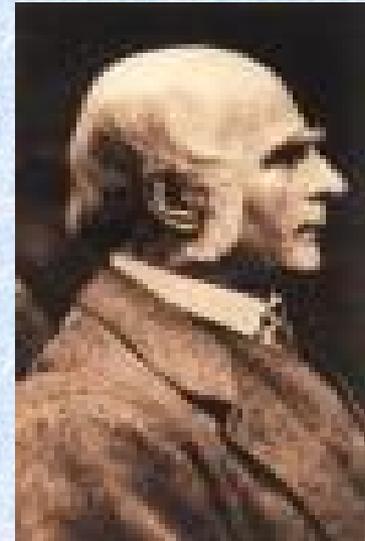
The Crucial Experiment

Genetics and Molecular Biology

A New Age of Medicine



Gregor Mendel
1822-1884



Francis Galton
1822-1911

1929 Werner Forssman
The First Cardiac Catheterization



The 1962 Nobel Prize

J. D. Watson and F. H. C. Crick

April 25, 1953

NATURE



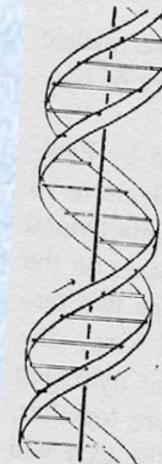
MOLECULAR STRUCTURE OF NUCLEIC ACIDS

A Structure for Deoxyribose Nucleic Acid

WE wish to suggest a structure for the salt of deoxyribose nucleic acid (D.N.A.). This structure has novel features which are of considerable biological interest.

A structure for nucleic acid has already been proposed by Pauling and Corey¹. They kindly made their manuscript available to us in advance of publication. Their model consists of three intertwined chains, with the phosphates near the fibre axis, and the bases on the outside. In our opinion, this structure is unsatisfactory for two reasons: (1) We believe that the material which gives the X-ray diagrams is the salt, not the free acid. Without the acidic hydrogen atoms it is not clear what forces would hold the structure together, especially as the negatively charged phosphates near the axis will repel each other. (2) Some of the van der Waals distances appear to be too small.

Another three-chain structure has also been suggested by Fraser (in the press). In his model the phosphates are on the outside and the bases on the inside, linked together by hydrogen bonds. This structure as described is rather ill-defined, and for this reason we shall not comment on it.



We wish to put forward a radically different structure for the salt of deoxyribose nucleic acid. This structure has two helical chains each coiled round the same axis (see diagram). We have made the usual chemical assumptions, namely, that each chain consists of phosphate di-ester groups joining β -D-deoxy-ribofuranose residues with 3',5' linkages. The two chains (but not their bases) are related by a dyad perpendicular to the fibre axis. Both chains follow right-handed helices, but owing to the dyad the sequences of the atoms in the two chains run in opposite directions. Each chain loosely resembles Furberg's² model No. 1; that is, the bases are on the inside of the helix and the phosphates on

Twenty First Century

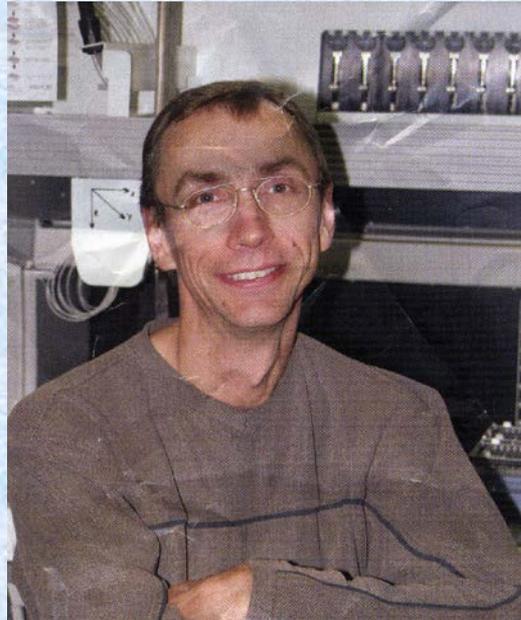
A Scientific *Tour de Force*

A 13 year effort to sequence 3.2 billion base pairs of DNA in the human genome was completed in April 2003.

We are living in an age that was once regarded as science fiction.

Sequencing the Neanderthal Genome 2010

Neanderthals appeared about 230,000 years ago. Svante Paabo at the Max Planck Institute in Leipzig, sequenced a Neanderthal genome which proved to be 99.5 percent identical with the human genome.



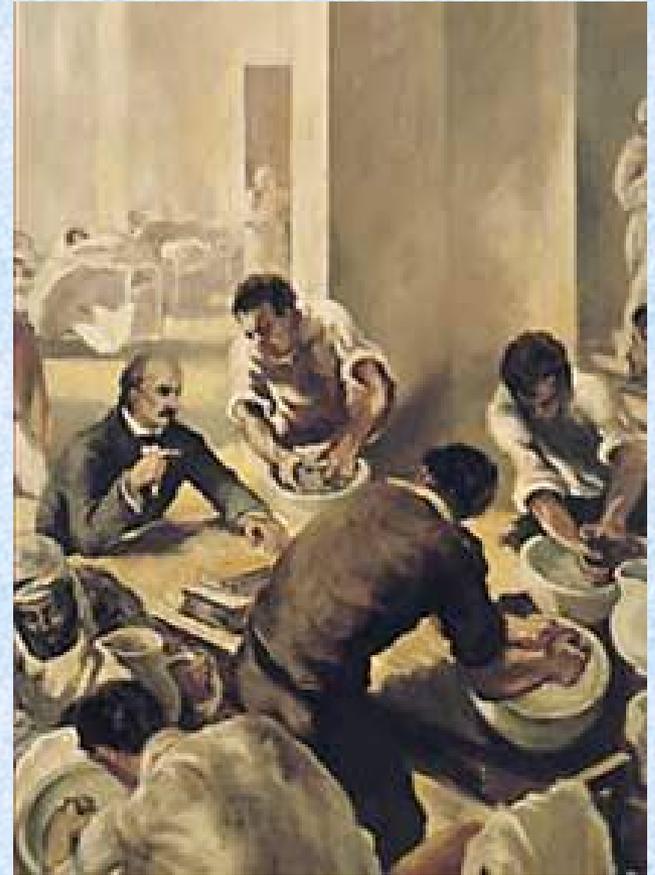
Svante Paabo

The Eighteenth Century

Puerperal Sepsis



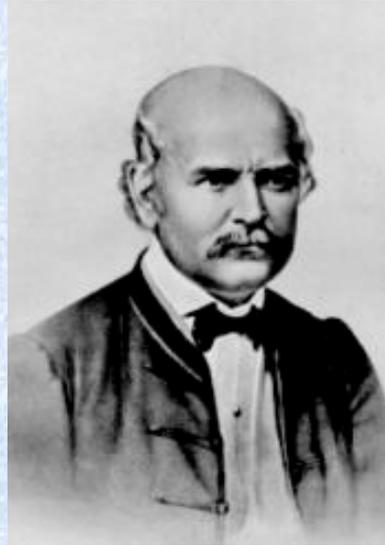
The
Cause



The Remedy

A Tragic Tale

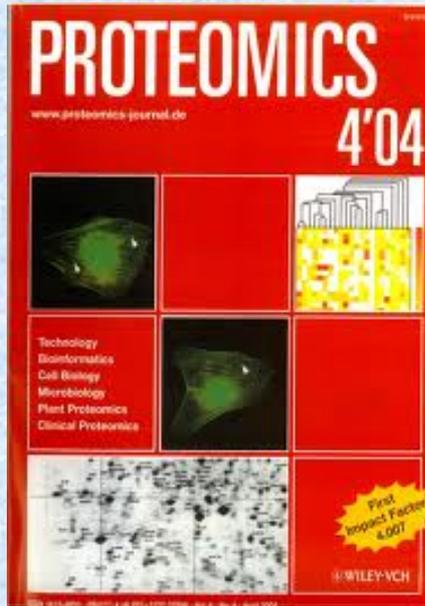
Ignac Phillip Semmilweis



1818-1865

Semmelweis discovered the etiology and prevention of puerperal sepsis. His agonizing travail to achieve acceptance of the discovery culminated in madness and death---one of the most tragic tales in the history of biomedical research.

Beyond the Genome



The DNA sequence is essential but insufficient in understanding cellular and molecular mechanisms. *Proteomics* provides a dynamic insight by characterizing the protein products of gene expression.

Medicine At Its best Is A Noble Profession

Best wishes to you all

