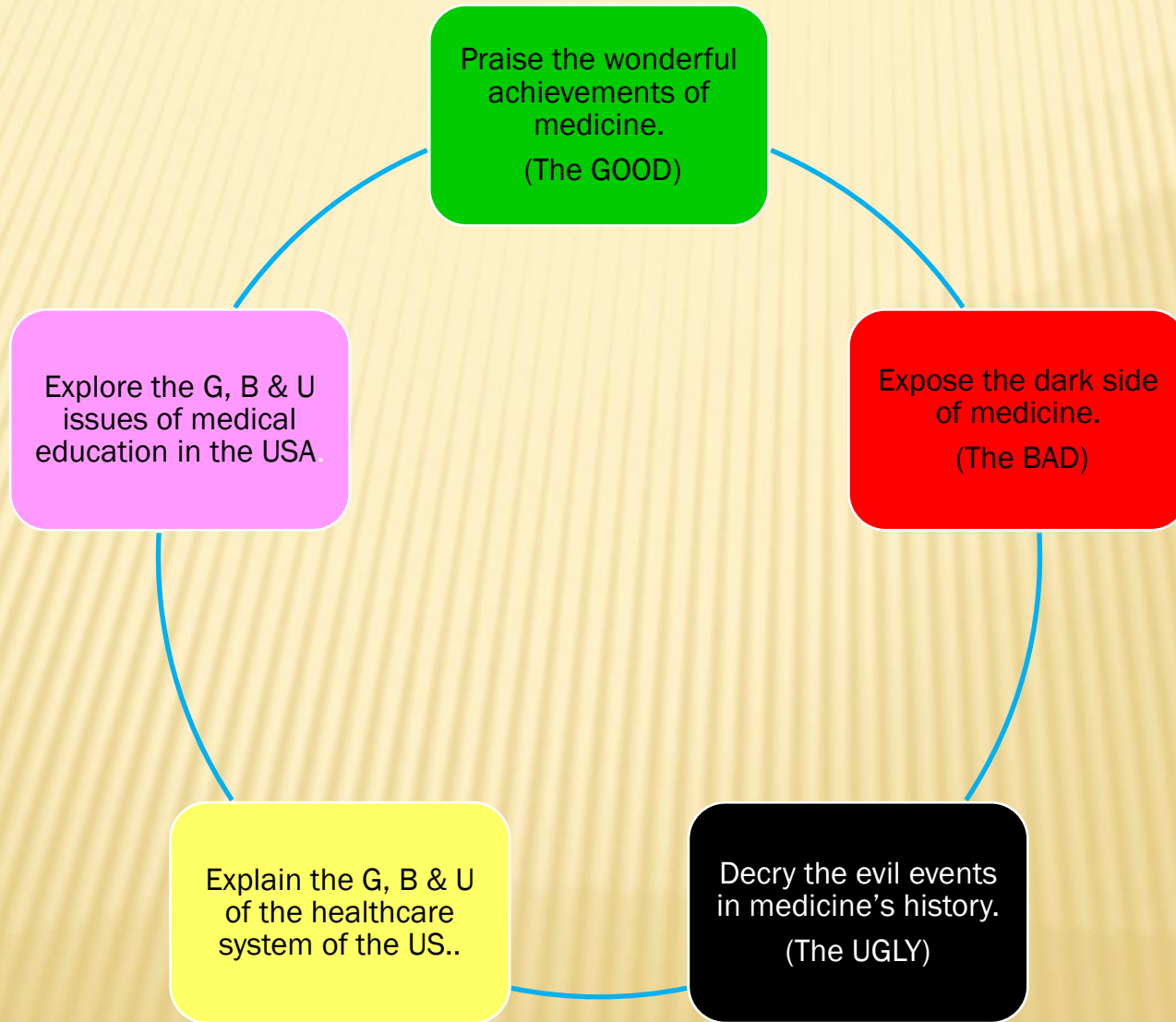




NOTES ON THE PRESENTATIONS

- ✘ Throughout the whole course, the following color code will be used as a visual aid:
 - + **Green**: Good or beneficial aspects of the person's beliefs or actions.
 - + **Red**: Negative, unethical, or incorrect beliefs or actions of a person.
 - + **Black**: Cruel, criminal, immoral or seriously inhuman acts.
- ✘ The limited selection or choice of examples is purely my own and does not reflect preference or neglect of other persons or acts in the history of Medicine.
- ✘ Many of the examples might not have been physicians, but scientists whose work was aimed towards the care of others.

COURSE OBJECTIVES



OVERVIEW OF COURSE

- × Session 1: History of Medicine as an Art and Science.
- × **Session 2: Invention of instruments, tools, diagnostic procedures.**
- × Session 3 : Rivalries between scientists and/or their countries.
- × Session 4 : Role of women and minorities in Medicine.
- × Session 5 : Social and medical behavior toward certain diseases.
- × Session 6 : Human medical experimentation throughout history.
- × Session 7 : US Healthcare system and international comparison.
- × Session 8 : US Medical education system: basis, issues, problems

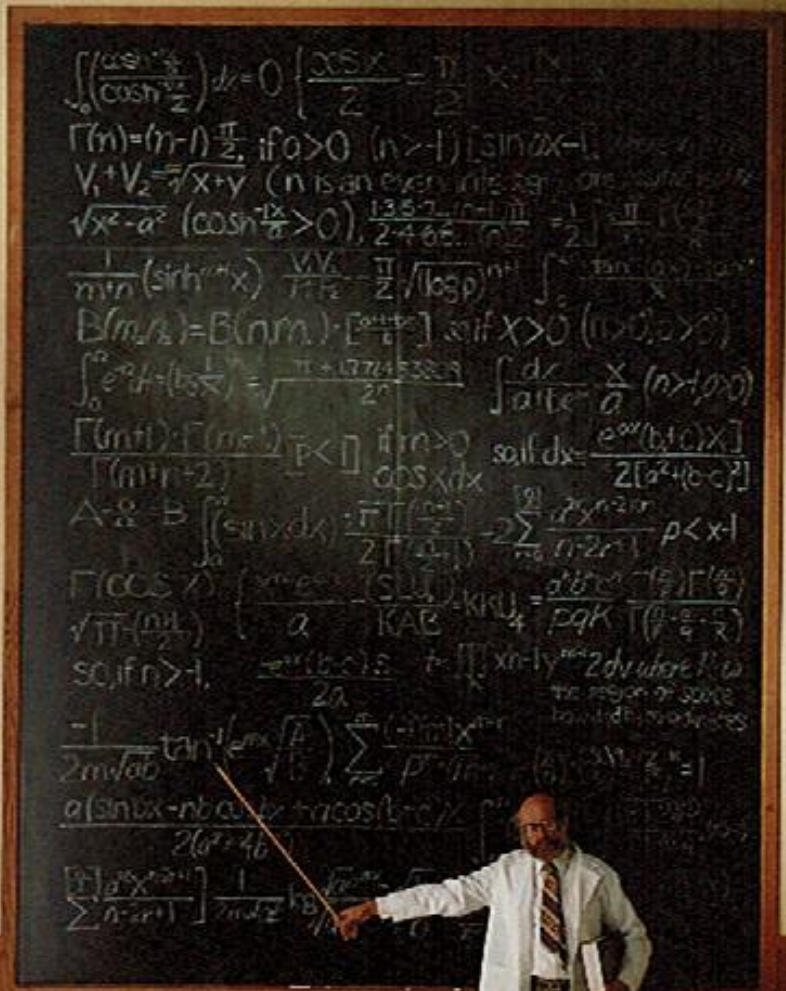
The Good

The Bad

The Ugly

Highs and Lows
Brightness and Darkness
Achievements and Disappointments
In the History of Medicine





I'll try to keep it simple!

MEDICINE

The history of medicine is, in fact, the history of humankind itself, with its ups and downs, its brave aspirations after truth and finality, and its pathetic failures.

Fielding Garrison, 1913

OLLI Spring Semester
Session 2 February 4, 2020

INVENTION OF INSTRUMENTS & TOOLS

OF INVENTORS AND DISCOVERERS (1)

**In Medicine and Science,
credit is given to the one who
perfects an idea and tells
others about it, not to the
one who has the idea first.**

Father of Microbiology

ANTONI VAN LEEUWENHOEK

ROBERT HOOKE (1635 - 1703)

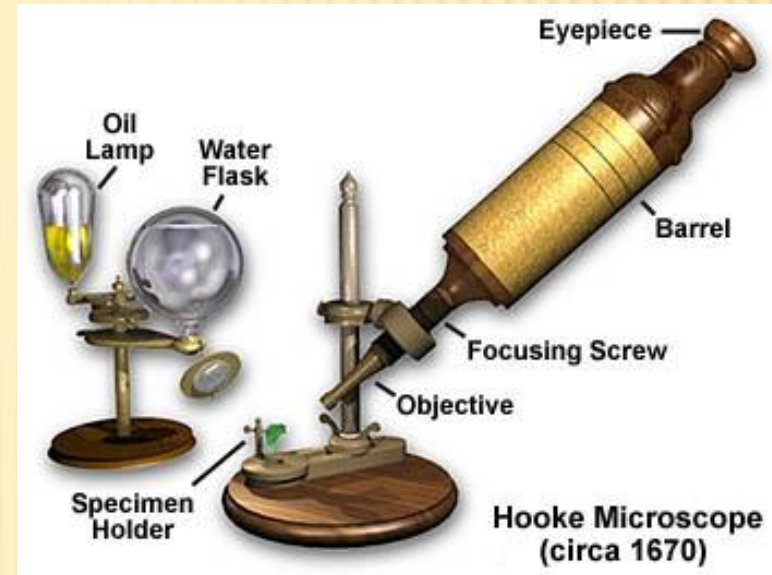
His 1665 book *Micrographia* described his studies with microscopes, and in it he coined the term *cell*.

His lenses had significant chromatic and spherical aberration with **very poor images**.

Fell short in optical performance when compared to the simple Leeuwenhoek microscope.

By the end of 17th century, Leeuwenhoek had a virtual monopoly on microscopic study and discovery.

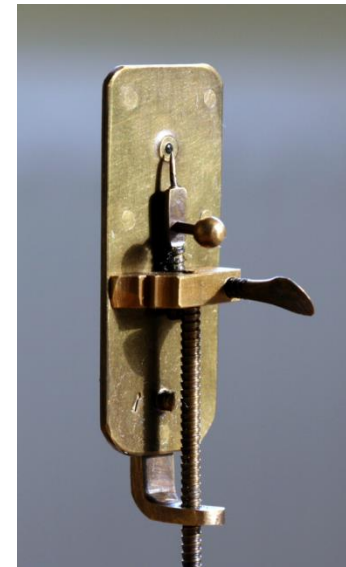
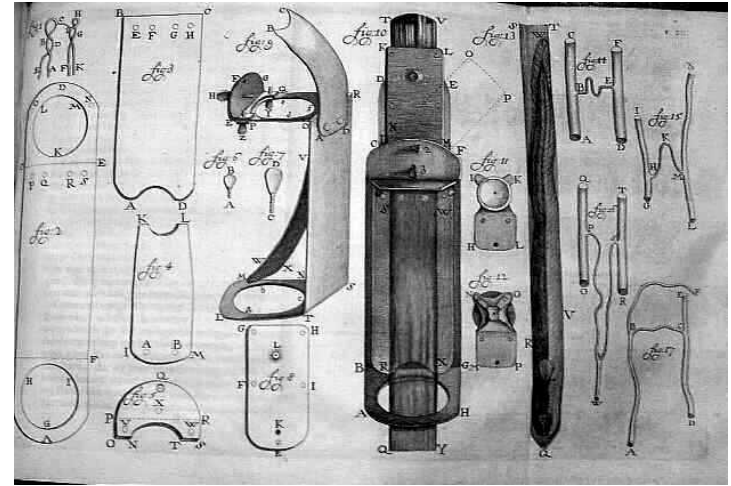
Hooke bemoaned that the field had come to rest entirely on one man's shoulders.



LEEUWENHOEK AND THE MICROSCOPE (1)

- ✘ Antoni Philips van Leeuwenhoek (1632-1723).
- ✘ Contemporary lenses enlarged at most 9-12X.
- ✘ His magnified from 40-270X (some say 500X !)
- ✘ Made single lenses of very high magnification.*

LEEUVENHOEK AND THE MICROSCOPE (2)



LEEUVENHOEK AND THE MICROSCOPE (3)

- ✘ Draper and bookkeeper, worked for the Court of Holland as a land surveyor and as Delft's "wine-gauger" (for import and taxation).
- ✘ Not a scientist, just a self-taught lens grinder.
- ✘ Persistent investigator and reliable observer.
- ✘ Built a new microscope whenever he found an interesting specimen that he wanted to preserve.

LEEUVENHOEK AND THE MICROSCOPE (4)

- ✘ First to describe living microscopic organisms.
- ✘ Named them “animalcules”.
- ✘ Royal Society initially rejected his findings.
- ✘ Experts sent to check him and get a microscope.
- ✘ He refused to lend or sell one!

LEEUVENHOEK AND THE MICROSCOPE (5)

- ✘ Royal Society team verified his results and made him a member in 1680!
- ✘ He corresponded with the Society (~560 letters) describing his observations and discoveries.
- ✘ He never suspected the minuscule creatures caused any kind of disease.
- ✘ His illness now called van Leeuwenhoek disease.

LEEUWENHOEK AND THE MICROSCOPE (6)

- ✘ First to see and describe living, moving unicellular organisms (bacteria).
- ✘ First to see circulating blood cells in capillaries.
- ✘ Refuted theory of *spontaneous generation*.
- ✘ Doctrine supported by Aristotle, Descartes, William Harvey, and Isaac Newton

LEEUWENHOEK AND THE MICROSCOPE (7)

- ✘ First to describe sperm.
- ✘ Postulated that conception occurred when a sperm joined with an ovum, but he thought that the ovum just served to feed the sperm.
- ✘ His studies of sperm and ovum of various species caused an uproar in the scientific community.

Inventor of the Stethoscope

RENÉ LAENNEC

OF INVENTORS AND DISCOVERERS (2)

- ✘ In science, discovery or invention is not just the work of the discoverer or inventor.
- ✘ It's not always an invention, most often a development.
- ✘ Someone has laid the groundwork, stated a principle or sparked an interest.
- ✘ Initial findings often get dismissed, laughed at, or ignored completely.
- ✘ Frequently rivalries, discords and outright accusations occur (session 3).

DEVELOPMENT OF THE STETHOSCOPE (4)

- ✘ Aunbrugger formally described percussion, wrote a book in 1758; it was neglected for 50 years.
- ✘ Couvisart translated it from German into French and published it in 1808.
- ✘ Laennec wanted to improve on percussion and devised a way of listening mediate.

DEVELOPMENT OF THE STETHOSCOPE (2)



Laennec

Corvisart

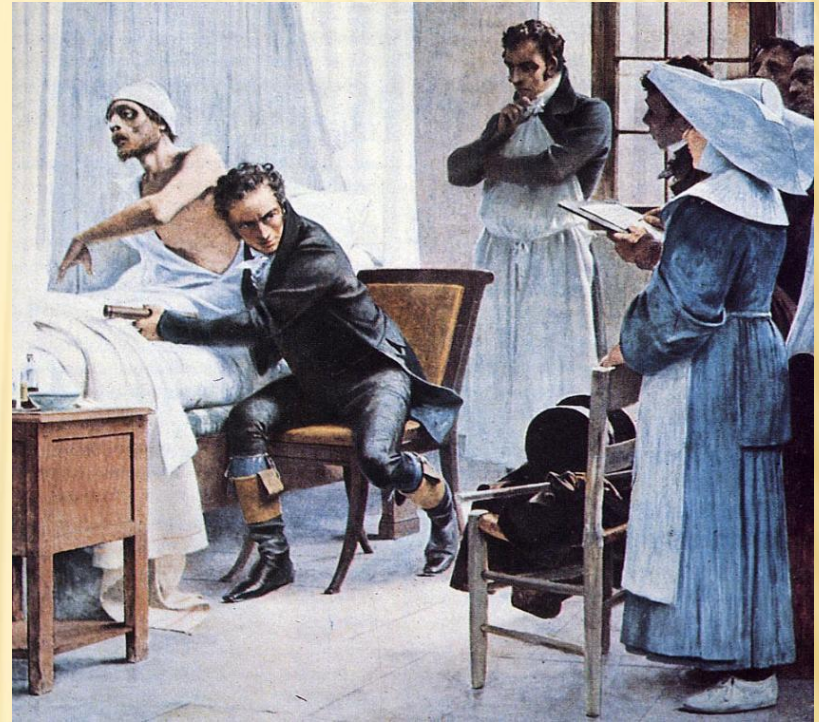
Auenbrugger

LAENNEC AND THE STETHOSCOPE (1)

- ✘ René-Théophile-Hyacinthe Laennec (1781-1826).
- ✘ French physician invented stethoscope in 1816.
- ✘ Also did work with cirrhosis and melanoma.
- ✘ Allowed doctor to clarify heart and lung sounds.

LAENNEC AND THE STETHOSCOPE (2)

- ✘ Physicians listened to patients' chest by direct (immediate) contact.
- ✘ He was not comfortable placing his ear on a woman's chest.
- ✘ Made a paper tube (later wooden) based on hearing trumpets.



TomasCabacas.com



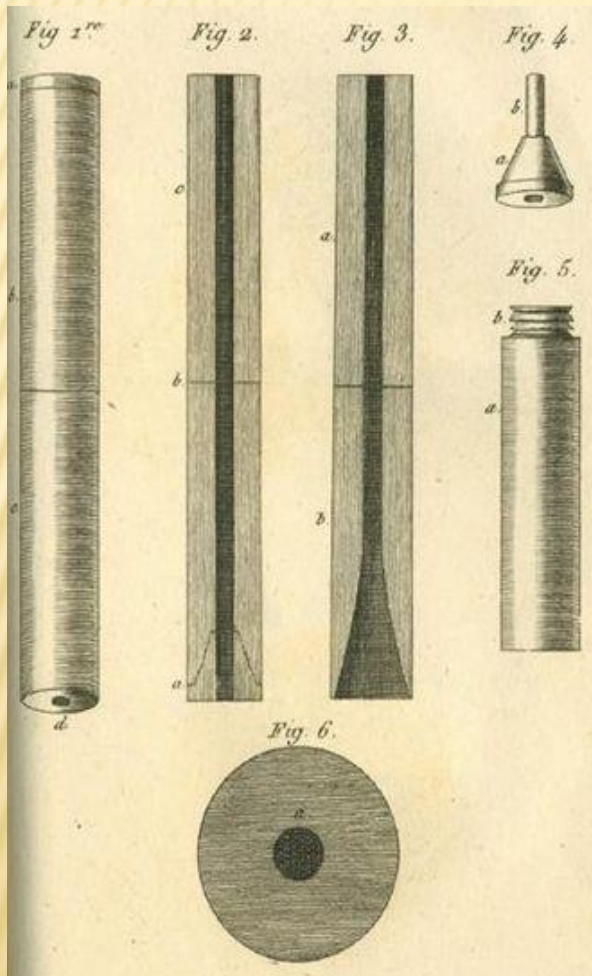
OF INVENTORS AND DISCOVERERS (3)

How science is actually done: a flash of insight followed by years of painstaking work.

LAENNEC AND THE STETHOSCOPE (3)

- ✘ Complemented percussion with auscultation.
- ✘ Made diagnosis of many illnesses by listening to breath and heart sounds.
- ✘ In 1819, published a 2-volume book on “*Mediate Auscultation with the Stethoscope*”.
- ✘ Cost: 16 francs including a stethoscope.

LAENNEC AND THE STETHOSCOPE (4)



- ✘ Design allowed for extension in case of dirty or pest-infested patients.
- ✘ Funnel design amplified low-frequency sounds.
- ✘ Could be carried in a coat pocket.

LAENNEC AND THE STETHOSCOPE (5)

- ✘ Created descriptive language for lung sounds:
 - + *Pectoriloquy*: hearing patient's voice through chest.
 - + *Rales*: crackling sound indicating lung congestion.
 - + *Ronchi*: rattling, hoarse, snore-like bronchial sounds.
 - + *Egophony*: High-pitched bleating (baa) sound.
- ✘ Able to diagnose consolidations, effusions, collapses, cavities, obstructions.
- ✘ He claimed to diagnose TB by the lung sounds.
- ✘ He himself died of tuberculosis at age 45.

LAENNEC AND THE STETHOSCOPE (6)

- ✘ Symbol of healthcare professionals.
- ✘ Positive impact on perceived trust of the practitioner.
- ✘ Evolved into a flexible tube and silicone diaphragm.
- ✘ Now, electronic devices are replacing the old classic.



Fetoscope (Pinard) to hear fetal heart tones.



DUPUYTREN

Baron Guillaume Dupuytren (1777-1835), famous surgeon of the early 1800's was one of the first surgeons to successfully drain a brain abscess using trepanation of the skull, and he also used the method to treat seizures and evacuate hematomas.

LAENNEC VS DUPUYTREN

- ✘ Laennec lectured on *melanoma* in 1804, published in 1805.
- ✘ Baron Guillaume Dupuytren (1777-1835), famous surgeon of the time said that Laennec had stolen the idea from his talks.
- ✘ Argued that there was no mention of his work or of his role in the discovery of melanoma in Laennec's lectures and writings.
- ✘ They had bitter disputes and exchanges (in person and by mail) over the years about this issue.
- ✘ They never officially reconciled.

Invention of the Electrocardiogram

WILLEM EINTHOVEN

DEVELOPMENT OF THE ECG

Einthoven

Waller

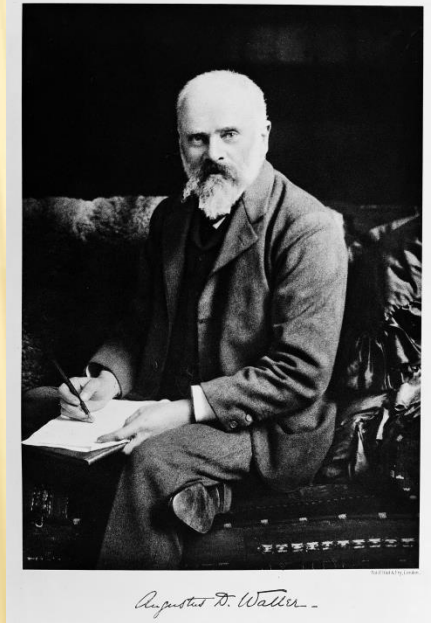
Lippman

Ostwald, Siemens

Galvani, Volta, Muirhead

AUGUSTUS DESIRÉ WALLER (1856-1922)

- ✘ First to use surface leads to show the curves of electrical activity of the human heart.
- ✘ In 1887 he recorded them using saline-filled tube electrodes and the capillary electrometer made by Gabriel Lippman.
- ✘ He lectured in Europe and America, using his dog Jimmy in his ECG demonstrations.
- ✘ Initially he did not think electrocardiograms would be useful in hospitals.
- ✘ Einthoven and Lewis showed him that the traces could help diagnose heart conditions.



← Jimmy

EINTHOVEN AND THE ECG (1)

- ✘ Dutch, born in Java, 1860-1927
- ✘ Invented electrocardiography in 1903.
- ✘ Translated electrical function of beating heart into a visual tracing for easy analysis.
- ✘ Received Nobel prize in 1924.

EINTHOVEN AND THE ECG (2)

- ✘ In 1905 did the a presentation of normal and abnormal electrocardiograms recorded with the string galvanometer.
- ✘ Presented cases of atrial and ventricular hypertrophy, ventricular bigeminy, ventricular premature beats and introduced the U (“unknown”) wave.
- ✘ The ECG’s recorded were transmitted by telephone wire from the patients in a hospital 1 mile away!
- ✘ He called them *telecardiograms*.

EINTHOVEN AND THE ECG (3)

- ✘ 1901: invents the string galvanometer using a fine quartz string coated in silver.
- ✘ Using findings from Muirhead, Lippman, and Waller, he designed his ECG machine.
- ✘ Sir Thomas Lewis (1881–1945) from England demonstrated the importance of ECG especially in heart rhythm disorders.
- ✘ Frank Norman Wilson (1890–1952) from USA was the father of the unipolar leads' in the frontal plane (aVR, aVL, aVF).
- ✘ Sir Thomas and Wilson became good friends with Einthoven, and both died at a relatively young age from acute infarction.

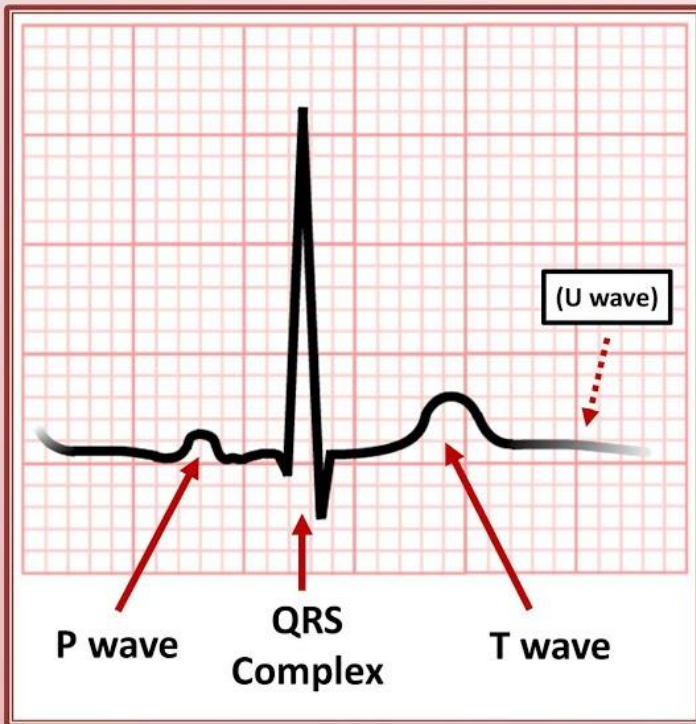
EINTHOVEN AND THE ECG (4)



1911 table model made by Cambridge Scientific Instruments Co.

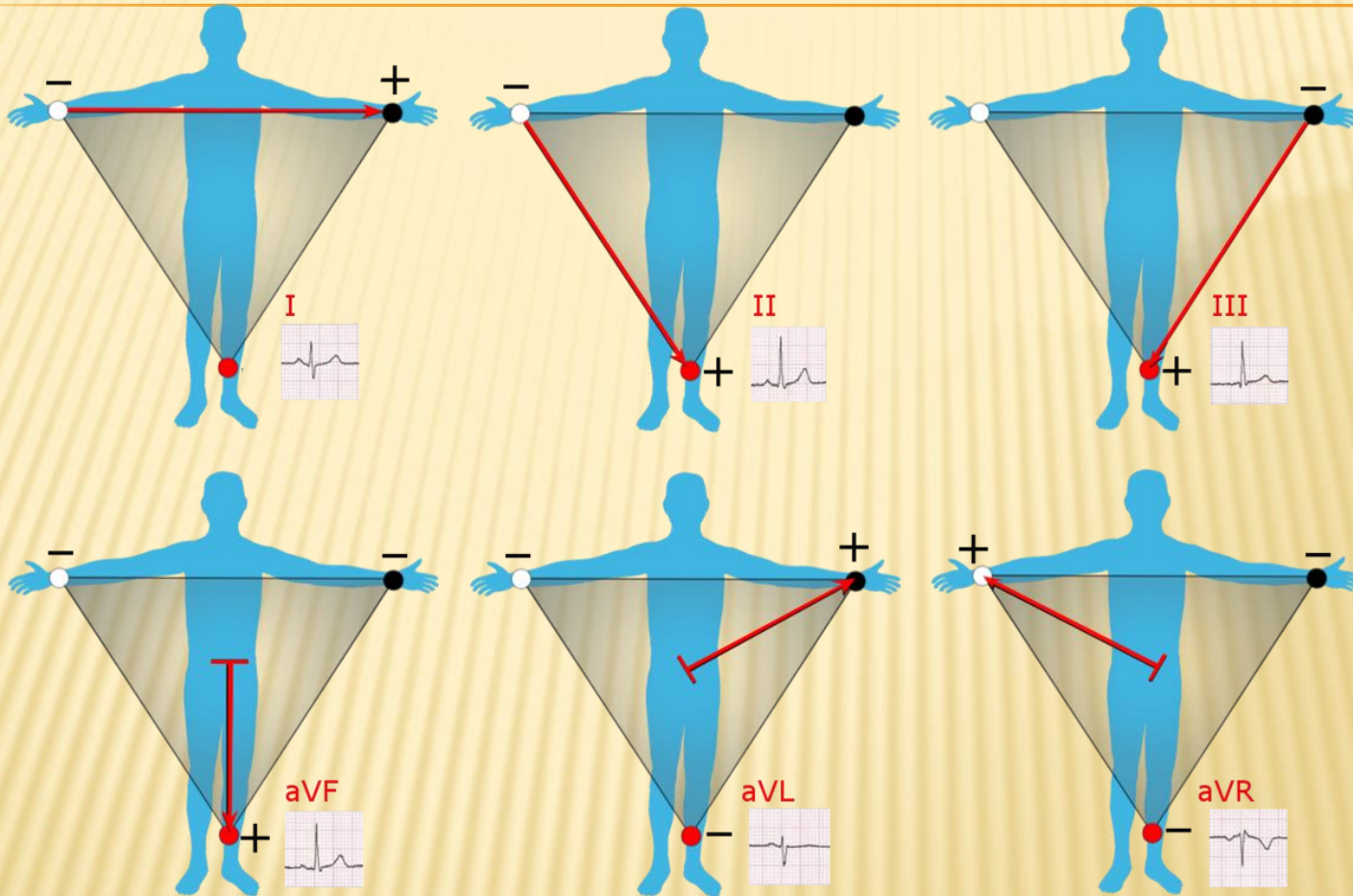
THE NORMAL ECG

Waveforms



- P wave: Atrial depolarization
- QRS complex: Ventricular depolarization
- T wave: Ventricular repolarization
- (U wave: Unknown)

EINTHOVEN'S TRIANGLE



The six-lead frontal plane ECG system

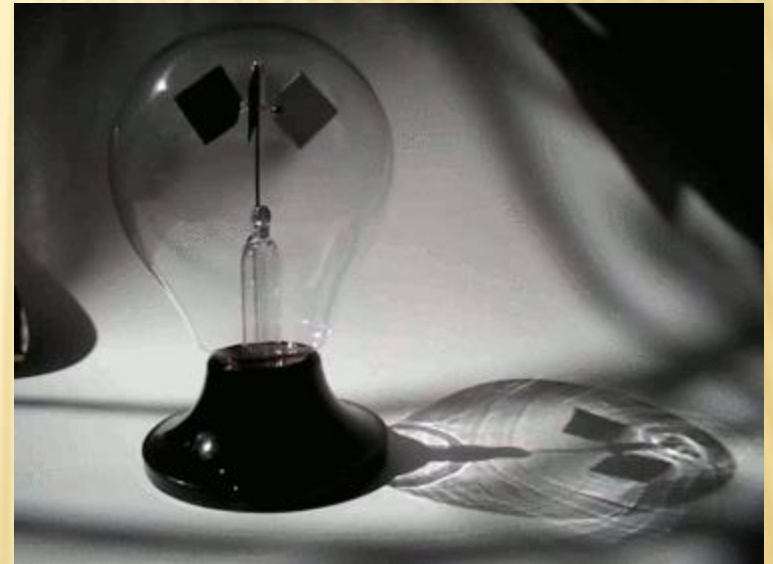
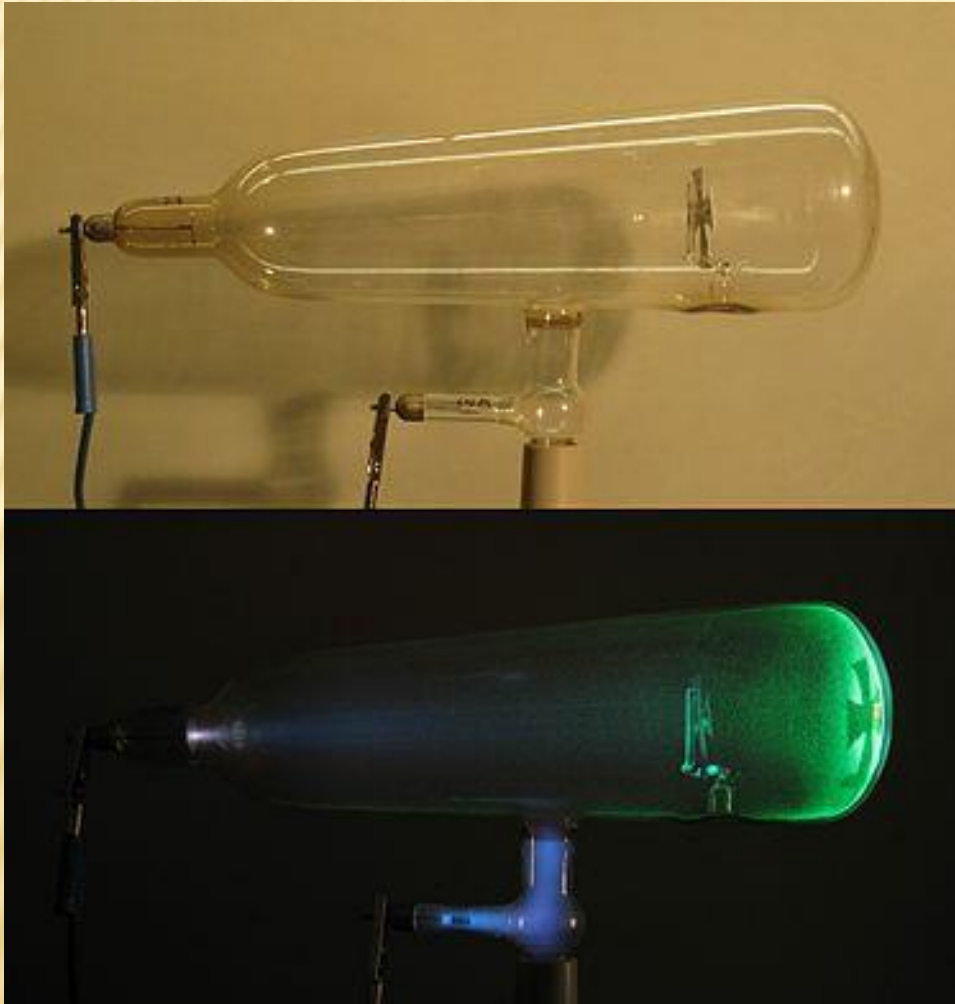
Discovery of X-Rays

WILHELM CONRAD RÖNTGEN

WILHEM RÖNTGEN (1845-1923) (1)

- ✘ Lived in Holland, birthplace of his mother.
- ✘ Went to Utrecht Technical School, was expelled.
- ✘ No HS diploma = No university in Holland.
- ✘ Went to Zurich Polytechnic, got a PhD.
- ✘ Became Physics Chair at Würzburg University .

CROOKES TUBE AND RADIOMETER



WILHEM RÖNTGEN (2)

- ✘ The cathode from covered Crookes tube emitted a ray that made an image on a barium plate.
- ✘ He called it “X” Ray for X=unknown.
- ✘ First Picture was of his wife’s hand.
- ✘ First public demo in 1896.
- ✘ Awarded the 1st Nobel Prize in Physics in 1901.

WILHELM RÖNTGEN (3)



Anna's hand



- January 23, 1896: took X-ray picture of hand of Prof. von Kölliker in Würzburg.

X-RAYS AND HAZARDS (1)

- ✘ Users unaware of dangers of X-Rays: carnivals & fairs.
- ✘ Used in stores to determine shoe fit.
- ✘ Use and abuse of dental X-rays.
- ✘ After 1895, many stories of burns, hair loss, and worse in technical journals of the time.
- ✘ Many experimenters at Edison's lab, including Nikola Tesla also reported burns.

X-RAYS AND HAZARDS (2)

- ✘ Up to 2010, 5 **Billion** medical imaging exams had been done worldwide.
- ✘ In 2006, medical X-Rays were about 50% of the total exposure of U.S.
- ✘ X-rays are determined a carcinogen by the WHO and the U.S. government.
- ✘ X-Ray exposure compared to background radiation:
 - + Chest X-ray = 10 days,
 - + Dental X-ray = 1 day.
 - + Abdomen or chest CT = 2–3 years (whole body) or 4–5 years (abdomen or chest),
 - + This increases lifetime cancer risk to about 1 /5,000 (2%), compared to the 40% chance of a US citizen developing cancer during their lifetime.

X-RAYS AND HAZARDS (2)

- ✘ The Greulich & Pyle Atlas used data from a study of growth/development on Caucasian children in USA from 1931 to 1942.
- ✘ X-Rays of left wrist and hand from birth till age 19 for males and age 18 for females.
- ✘ Over 1,000 children X-rayed every 3 months to 1 year.
- ✘ No source expresses concern for exposure.

INVENTION OF THE THERMOMETER

THE THERMOMETER

- ✘ The thermometer was made by the work of many scientists and improved upon by many others.
- ✘ In 1612 Sanctorio Santorii became the first to put a numerical scale on a thermoscope.
- ✘ In 1654, the Grand Duke of Tuscany, invented the first enclosed liquid-in-a-glass thermometer.
- ✘ He used alcohol as his liquid, but it was still inaccurate and had no standardized scale.

GALILEO GALILEI'S THERMOSCOPE

- ✘ In 1593 Galileo invented a water thermoscope, which allowed temperature variations to be measured.
- ✘ He found that the density of a liquid varies with temperature, so increasing its temperature decreases its density.
- ✘ Size of each bulb is made to be less than $\frac{1}{2}$ the tube diameter so they can pass each other in the tube and not jam up.
- ✘ **Lowest** floating bulb gives the approximate temperature.



SANCTORIO SANTORII (1561-1636)

- ✘ In 1612, applied a scale to an air thermoscope.
- ✘ Initial devices did not measure temperature.
- ✘ His instrument was an air thermometer with poor accuracy due to varying air pressure.
- ✘ Neither Galileo's nor Santorio's instruments were very accurate.

DANIEL GABRIEL FAHRENHEIT (1686-1736)



- ✘ Between 1709 and 1724, he created the 1st thermometer with a scale.
- ✘ He invented the alcohol, and mercury thermometers, and the fixed temperature scale.
- ✘ Originally set 0° as the temp of a mixture of water, ice and salt and 100° as the human body temp.

TEMPERATURE SCALES

- x The Fahrenheit and Celsius scales converge at minus 40° degrees, so that minus 40°F and minus 40°C represent the same temperature.
- x The Centigrade scale, (now Celsius), made 100° the freezing point and 0° the boiling point of water !! (now the opposite).
- x The Kelvin scale was invented by Lord Kelvin.
- x The kelvin is not written as a degree; it is the primary unit of temperature in physical sciences, but is used in conjunction with the degree Celsius, which has the same magnitude.

Invention of the Sphygmomanometer

VON BASCH

PRECURSORS TO SPHYGMOMANOMETRY



1628,
Harvey,
establish
circular
flow of
blood.



1733
Hales,
measured
blood
pressure.



1828
Poiseuille,
Mercury
in U-tube.



1855
Vierordt,
recorded
blood
pressure.



1860
Marey,
improved
Vierordt's
procedure



1876
von Basch
eliminate
arterial
puncture.



1896
Riva-
Rocci,
wrap
whole
arm.



1905,
Korotkoff,
auscultate
diastolic
pressure.

Evolution, improvements, designs, persistence, dedication.

BASCH AND SPHYGMOMANOMETER (1)

- ✘ Samuel Siegfried Karl Ritter von Basch (1837-1905),
- ✘ Austrian-Jewish physician personal physician of emperor Maximilian of Mexico.
- ✘ Remained with Maximilian until his execution by firing squad at Querétaro on 19 June 1867.
- ✘ Invented the sphygmomanometer in 1881.

BASCH AND SPHYGMOMANOMETER (2)

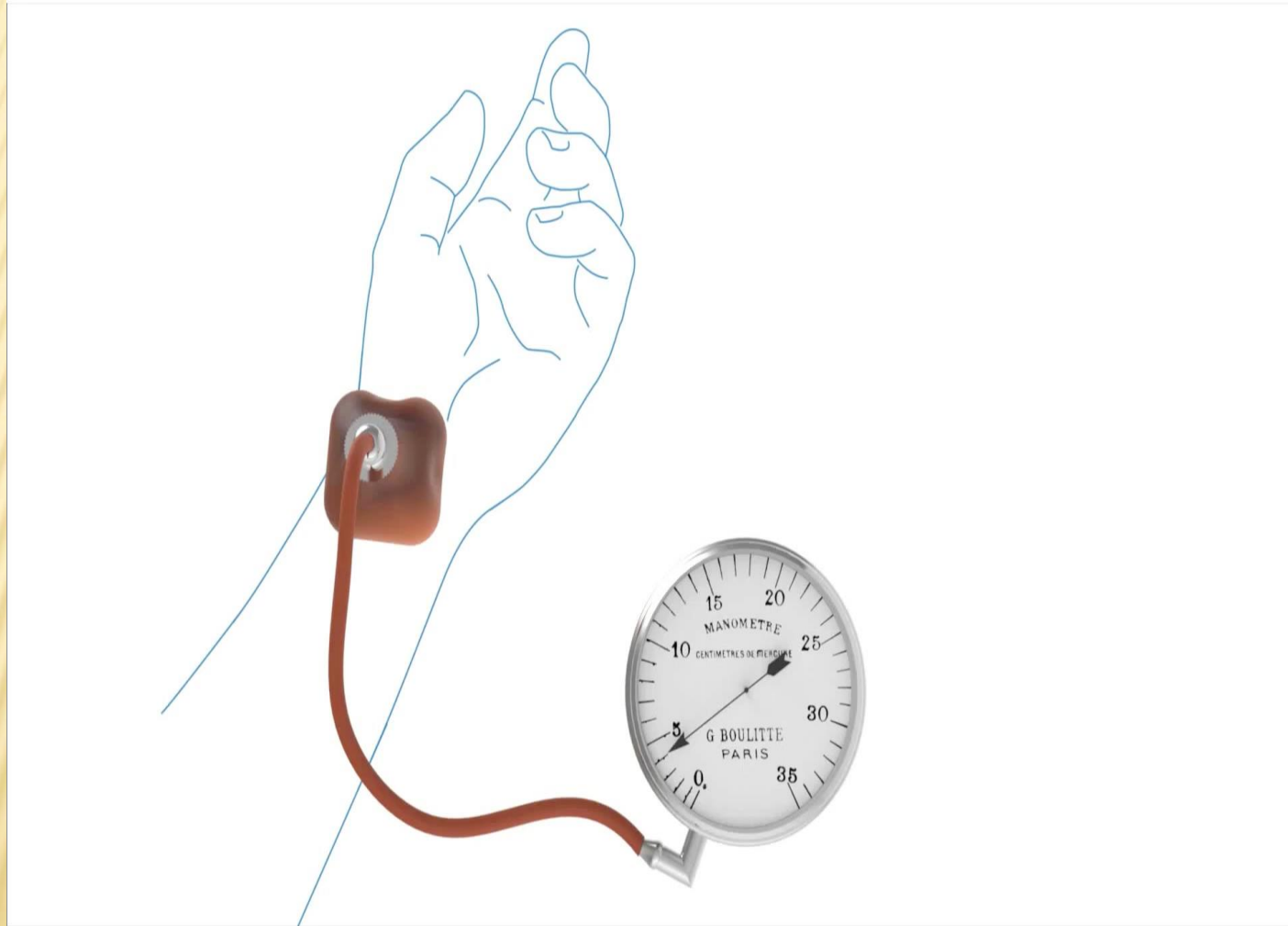
- ✘ Sphygmomanometers
 - + *Sphygmos*: pulse
 - + *Manos*: thin, scarce
 - + *Metron*: measure
- ✘ Physicians of the time preferred old techniques. such as using finger pressure to restrict flow.
- ✘ *British Medical Journal* said: “[they] pauperize the senses and weaken clinical acuity.” (1883)

VON BASCH SPHYGMOMANOMETER (1)



- ✘ Portable model.
- ✘ Pressure on vessel done with water-filled ball.
- ✘ Connected to mercury scale.
- ✘ Measured systolic pressure.

VON BASCH SPHYGMOMANOMETER (2)



MRI

PAUL LAUTERBUR

NMR AS PRECURSOR TO MRI

- ✘ The existence of Nuclear Magnetic Resonance was predicted by a Dutch physicist, Gorter, who tried to show it in lithium fluoride in 1936.
- ✘ In 1946, Felix Bloch and Edward Purcell, working independently, demonstrated the existence of NMR.
- ✘ Bloch's observations were made with studies of water at Stanford; Purcell's with studies of paraffin wax at Harvard.
- ✘ They were jointly awarded the 1952 Nobel in Physics.

PAUL CHRISTIAN LAUTERBUR (1929 – 2007) (1)

- ✘ In 1971, Lauterbur had the idea that information from NMR signals could be made into images from a living subject.
- ✘ He developed the idea despite widespread skepticism and criticism.
- ✘ He used related work by other scientists:
 - + Robert Gabillard, gradients in the magnetic field.
 - + Peter Mansfield (Lauterbur's Nobel co-recipient).
 - + Raymond Damadian (feuded with Lauterbur over credit for the ideas behind MRI, was denied the Nobel).
 - + Bloch and Purcell, NMR, 1952 Nobel

PAUL CHRISTIAN LAUTERBUR ⁽²⁾

- ✘ In 1973, paper sent to *Nature*, but it was rejected because the pictures were too fuzzy.
- ✘ He called the process zeugmatography.
- ✘ Resubmitted it and then was accepted.
- ✘ Received joint Nobel with Mansfield in 2003.

HOW MRI WORKS

Most of the human body is made up of hydrogen and oxygen atoms (water).

At center of each hydrogen atom is a particle called a proton.

Protons are like tiny magnets and are very sensitive to magnetic fields.

Under the scanner magnets, your protons align.

Short bursts of radio waves knock protons out of alignment.

When the radio waves are turned off, the protons realign.

Receivers pick up new radio signals, which help to distinguish between tissues in the body.

RAYMOND DAMADIAN

- ✘ Raymond Damadian, a New York MD did earlier work using NMR to analyze malignant tissues.
- ✘ Damadian & Lauterbur received the Medal of Technology from President Reagan in 1988.
- ✘ He was inducted into the National Inventors Hall of Fame in 1989.
- ✘ Patented NMR for cancer detection in 1974.
- ✘ His name was not included in the 2003 Nobel.

QUESTIONS ?



