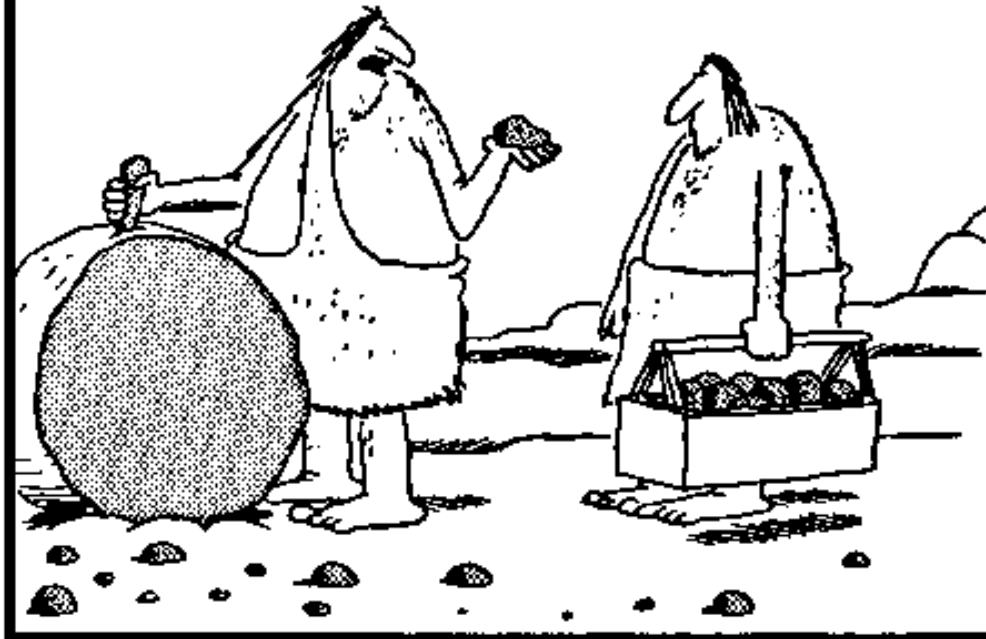


HISTORY OF SCIENCE

Lauren

Early Evidence for Human Reliance Upon a Natural Perspective



“So what’s this? I asked for a *hammer*!
A hammer! *This* is a crescent wrench! ...
Well, maybe it’s a hammer. ... Damn these stone
tools.”

Prehistoric Period

- Learning by trial and error
- Rich natural history knowledge
- Information not written down
(paper & writing developed ~5K years ago)
- Crops Domesticated

When did the study of science begin?

Paleolithic paintings on cave walls and recordings on bones- observations

32,000 years ago



When did the study of science begin?

Mesopotamian

7,000 B.C. to 6th century B.C.



Medical text



Astronomy



Bronze surgical knives

Ancient Greece

Hippocrates (460 – 370? B.C.)



- Greek physician
- Diseases have natural causes
- Rejected view that disease caused by evil spirits
- Believed that the brain was area of higher thought and emotion, not heart
- Program for good health: rest, good nutrition, and exercise.
- Started “Western Medicine”

Roman Times



Galen (130 - 200 A.D.)

- Anatomy & Physiology
- disease resulted from an internal imbalance of the four humors
- Mistakes in understanding circulation
- Research based on ape dissection
- Textbook used for 1000 years

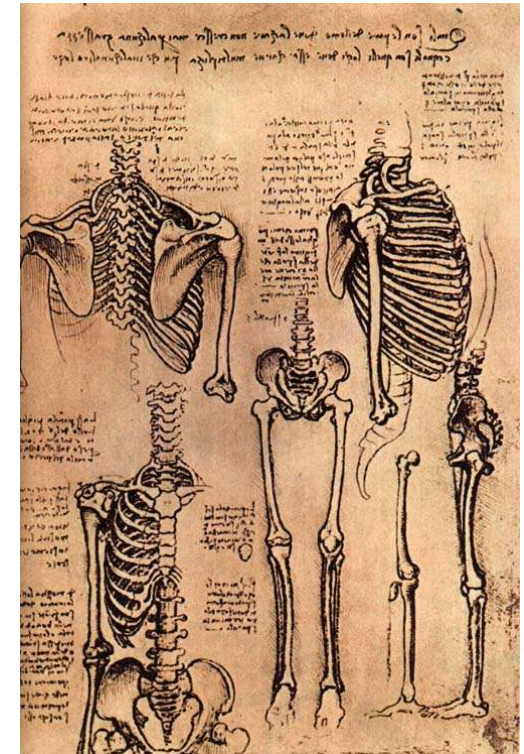
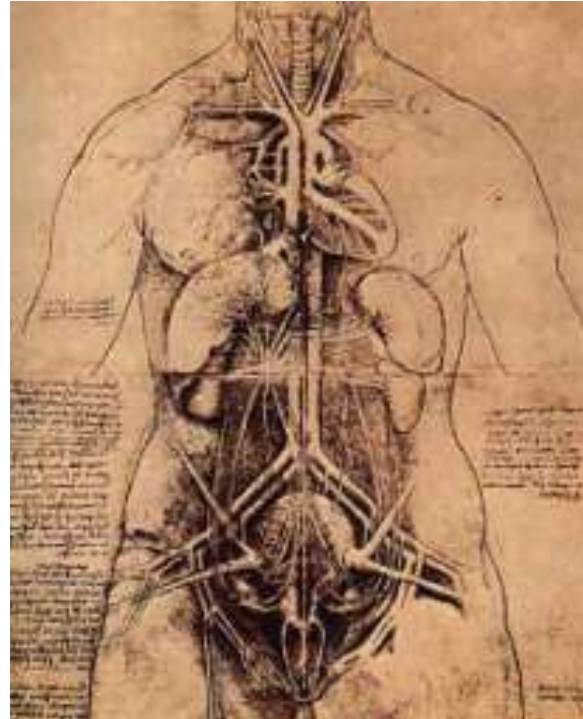
Dark Ages- 200 to 1200 A.D.

- Sad time
- Little new knowledge
- Taboo against dissecting human cadavers continued
- Avoided actual involvement
- Authority prevails

Renaissance

da Vinci(1452-1515)

● Anatomy & Physiology



Renaissance

Vesalius (1514-1564)

- Anatomy & Physiology
- Followed Galen's writings, but later found he was wrong



Vesalius dissects a female cadaver in his anatomy lab

Medieval Human Anatomy Before Vesalius



Scientific Revolution(s)

The Scientific Revolution is a term commonly referring to the transformation of thought about nature through which the Aristotelian tradition was replaced by so-called "modern" science.

Most see it as a series of events focused in the period 16th and 17th century or, more precisely, from 1543 (De Revolutionibus of Copernicus) to 1687 (Principia of Newton). Others grant it some status from 1300 to 1800.

Still others, see revolutions all around, Glorious, American, French, Industrial, Chemical, Darwinian, Freudian, Russian, Quantum, and Plate Tectonics.

Revolution, revolutions, or evolution of ideas, it depends on who you read.

History of Science...

Studies the change of natural knowledge claims over time and also the causes of these changes.

A vast field (Plato-NATO) embracing many different scientific traditions, from **A**lgebra to **Z**oology.

“Today’ s science is tomorrow’ s history of science.”

“Science dynamics.”

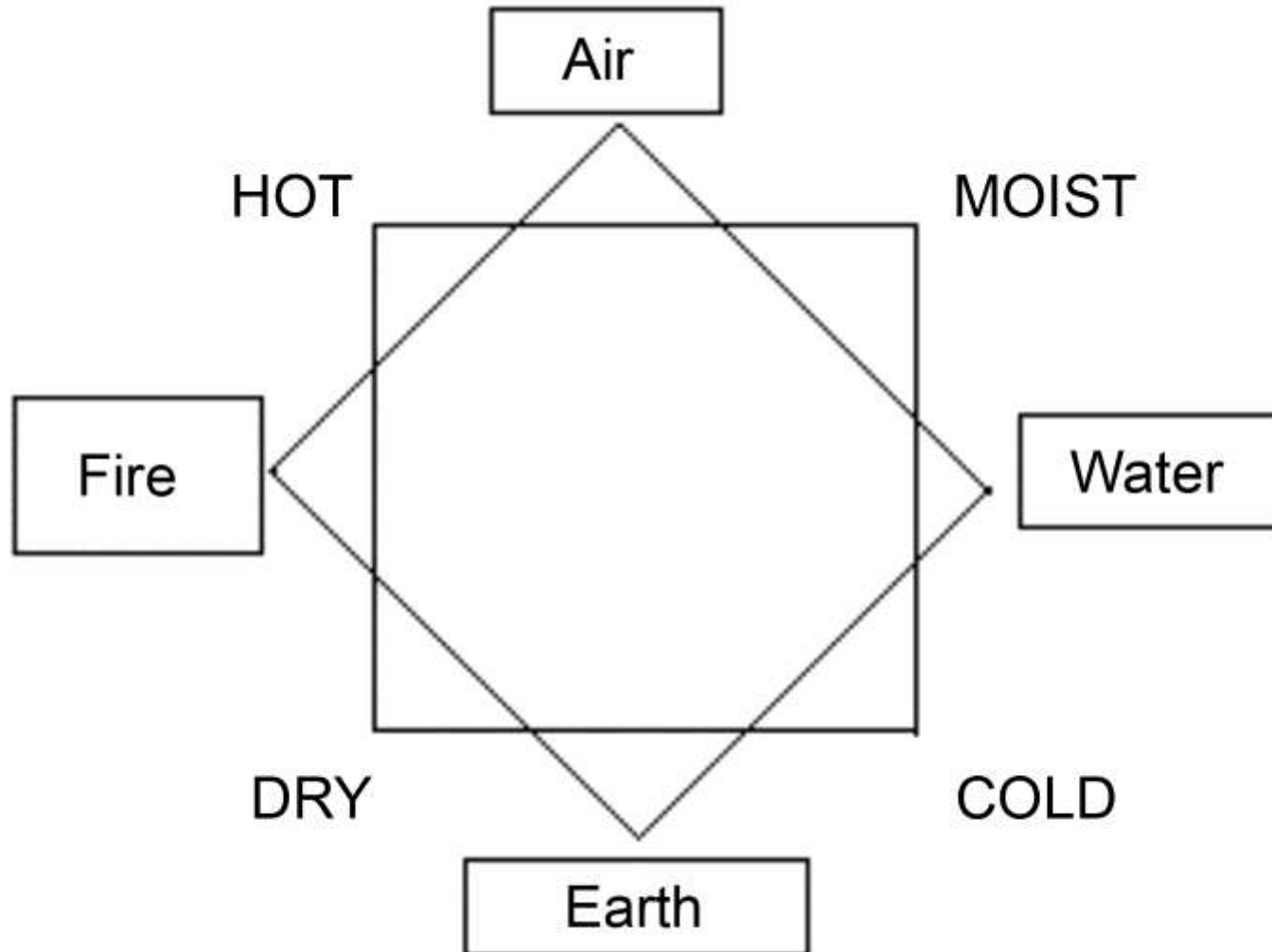
Aristotle (384-322 BCE)

- ⊕ Tutor to Alex the Great
- ⊕ Scala Natura
- ⊕ His philosophy later adopted by the Christian West
- ⊕ Founded the Lyceum, (peripatetic school) which emphasized natural philosophy.



- ⚡ Aristotle created a hierarchy of all living things, from simple to more complex. Although he did not mean to imply evolution, it nevertheless ranked all of creation from great to small.**
- ⚡ This later became the “Great Chain of Being” – a hierarchically ordered system with God & angels at the top, progressing downward from more to lesser developed (moral/perfect) beings.**

Aristotelian natural philosophy



Aristotelian Cosmology

Sublunar realm:

Natural place and natural motion

Generation and corruption

Four elements: earth, water, air, and fire

Cold, hot, moist, dry, affinity and opposition

Heavens:

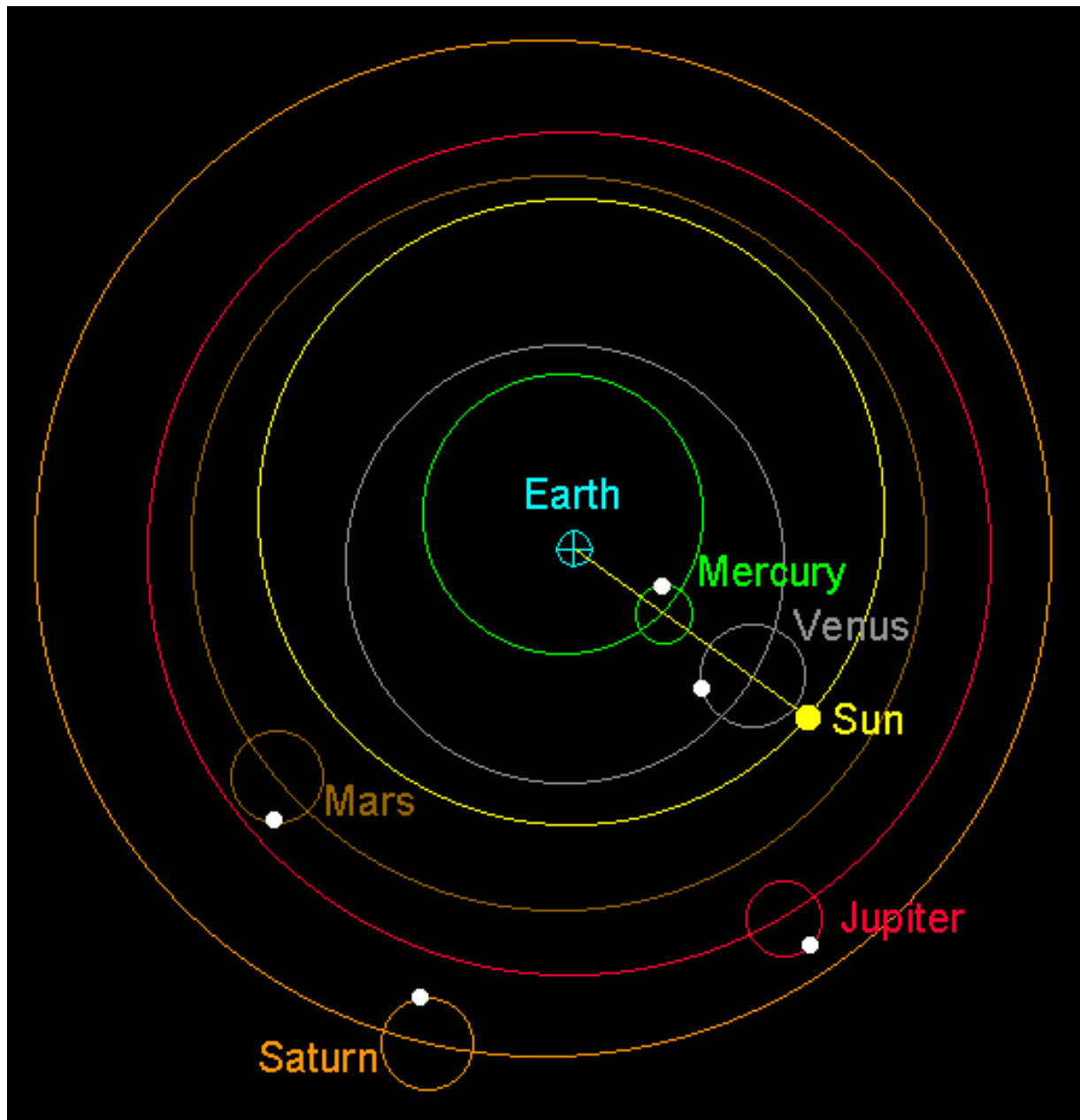
Uniform circular motion

Perfect and incorruptable

Quintessence or aether

Ptolemy

- ✦ **Created a Geocentric model of the universe.**
- ✦ **This worked pretty well for a long time – especially for planets. But, eventually, errors would be detected (once math & technology developed more).**



Greek Civilization

✦ It is difficult to underestimate the contributions of Greek philosophy, science, art, literature, etc. to our Western way of thinking. Although they were “pagans” (as later Christians would think), much Greek thought was incorporated into the Christian European tradition. Nevertheless, the sense of curiosity that drove Greek intellectual developments would not be adopted in the west until the Renaissance.

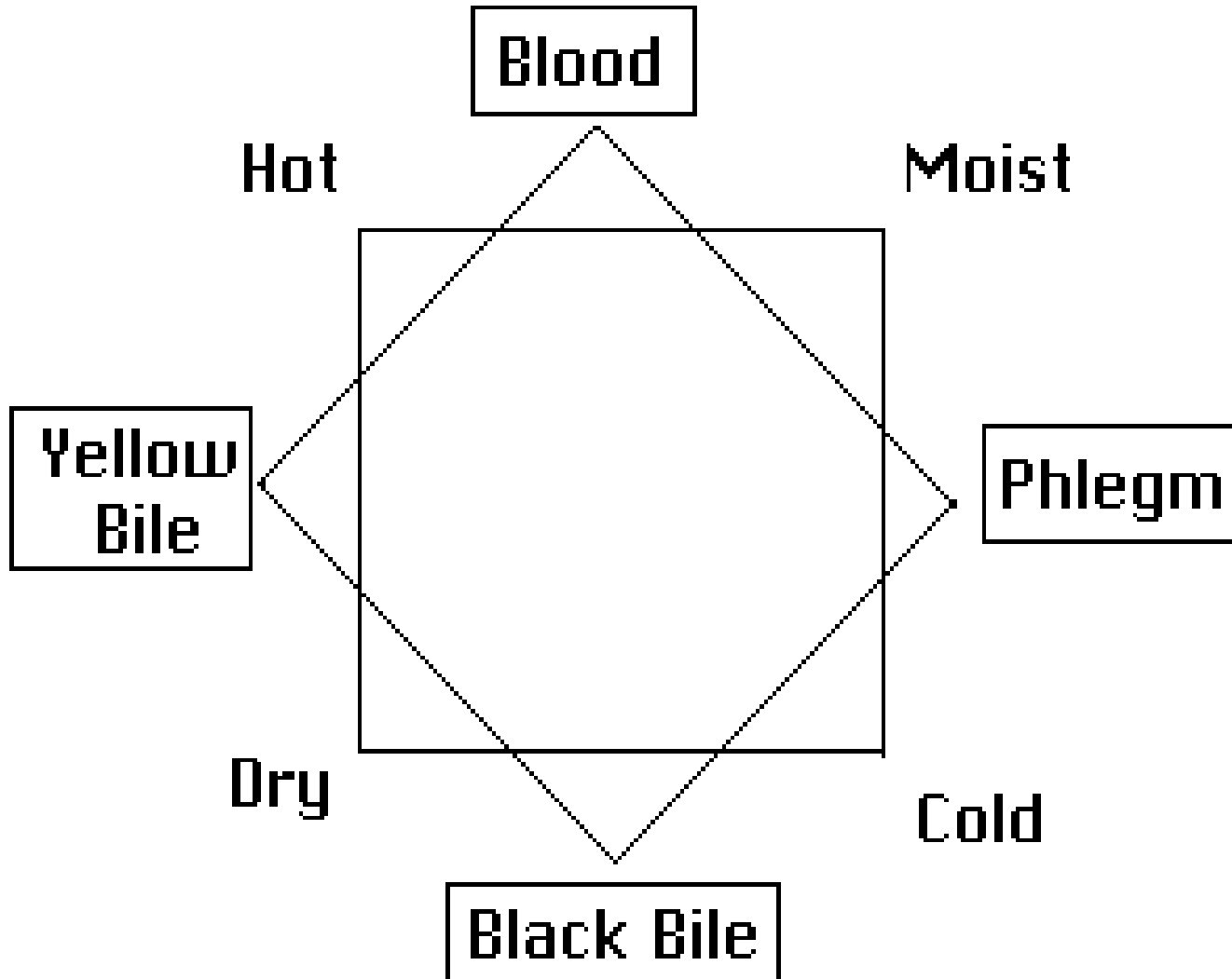
Hippocrates, *Airs, Waters, Places*

Emphasized the effects of climate and other geographical factors on human health.

Climate is a primary influence, but human institutions could have a moderating effect.

Overall, however, the relationship between health and lifestyle is under the direct influence, if not the control, of airs, waters, and places.

Hippocratic medicine



European Medieval thinking

- ✦ After the fall of the Roman Empire (~478 AD), Europe would be politically fragmented and a period of intellectual conservatism would be the norm.
- ✦ Meanwhile, Arab civilization would be the center of intellectual development – esp. in mathematics, optics, medicine.
- ✦ In Europe, intellectual activity would be under the purview of the church – monasteries would be the loci of study, contemplation, documentation.

⊕ According to the Church, all that could be known about the world came from the bible.

⊕ Creation had been perfect

⊕ Degeneration: after people were tossed out of Eden, it was all down hill – the further history moved away from creation, the more evil grew and the 2nd coming would restore God's kingdom.

⊕ Likewise, the further one got from the holy land, the more degenerate would be those societies.

Scientific Revolutions

The “New World”

- ✦ The “discovery” of the Americas was one of the most important events in European history (although historians mostly focus on the impact of Europe on the Americas).
- ✦ There were several troubling aspects to the discovery.

- ✚ **First, the Bible had absolutely nothing to say about the Americas – not its location, people, history, etc.**
- ✚ **Europeans came into contact with people entirely ignorant of God, Christ, etc.**
- ✚ **The plants and animals of the Americas were unknown – although there were some that were the same.**

⊕ This led to

1) recognition that the Bible was not the ultimate authority on nature

2) debate over the nature of Indigenous people (were they animals or humans?)

3) classification of the animals & plants.

4) the fact that no one knew anything about the Americas sparked curiosity – the need to know.

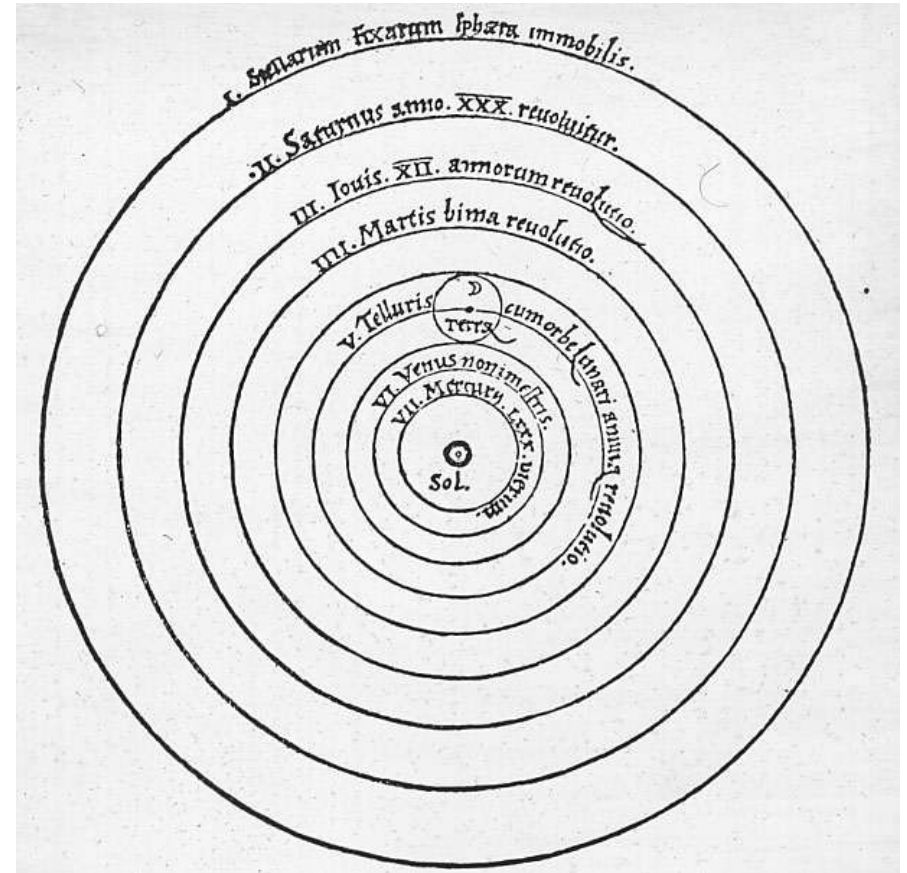
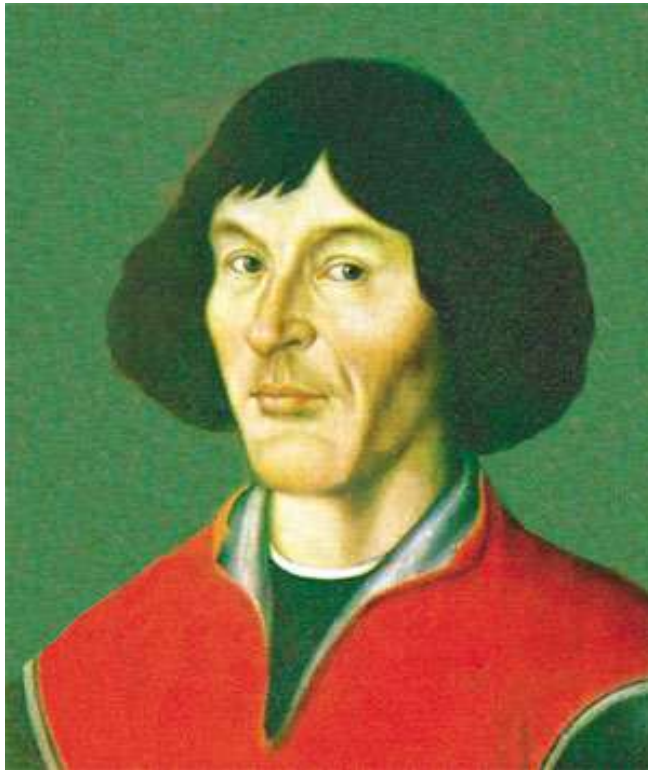
Of course, there were many other ramifications to European domination of the Americas –

- ⌘ Economic: commerce would eventually lead to the industrial revolution**
- ⌘ Power: struggles over control of the colonies and their wealth would spark intense competition between European nations (Spain vs. Britain, etc.)**
- ⌘ Politics: Liberalism (our current form of government) would have its first experiment in the Americas (USA).**

Our concern here, however, is in science.

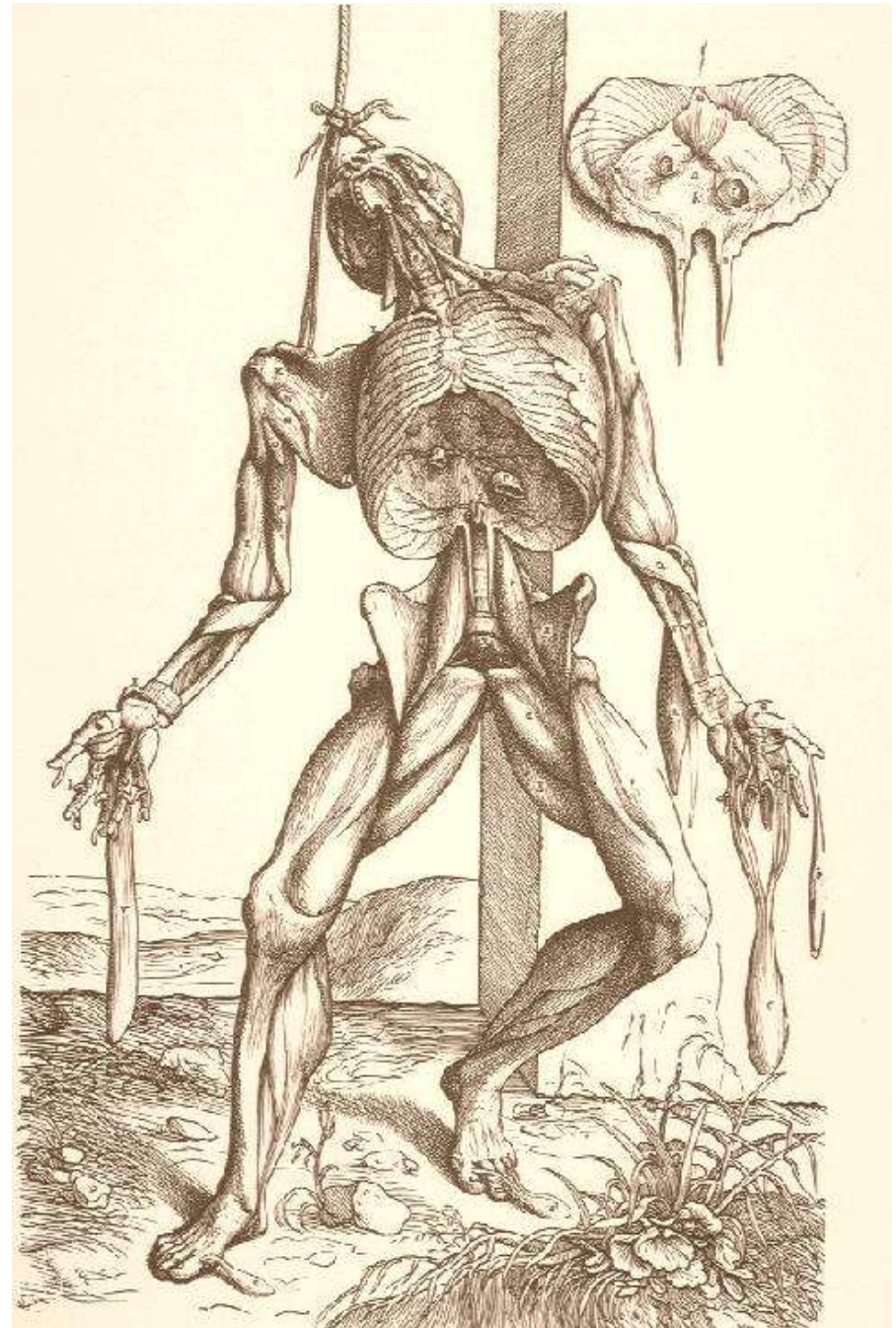
- ⊕ The discovery of the new world began a process of separation of church and science.**
- ⊕ Many would try to reconcile science & religion, but ultimately, science would largely reject theology as a way of knowing the natural world.**
- ⊕ This would be a difficult period with many wounded – but the process was more or less inevitable.**

Nicholas Copernicus (1473 – 1543)

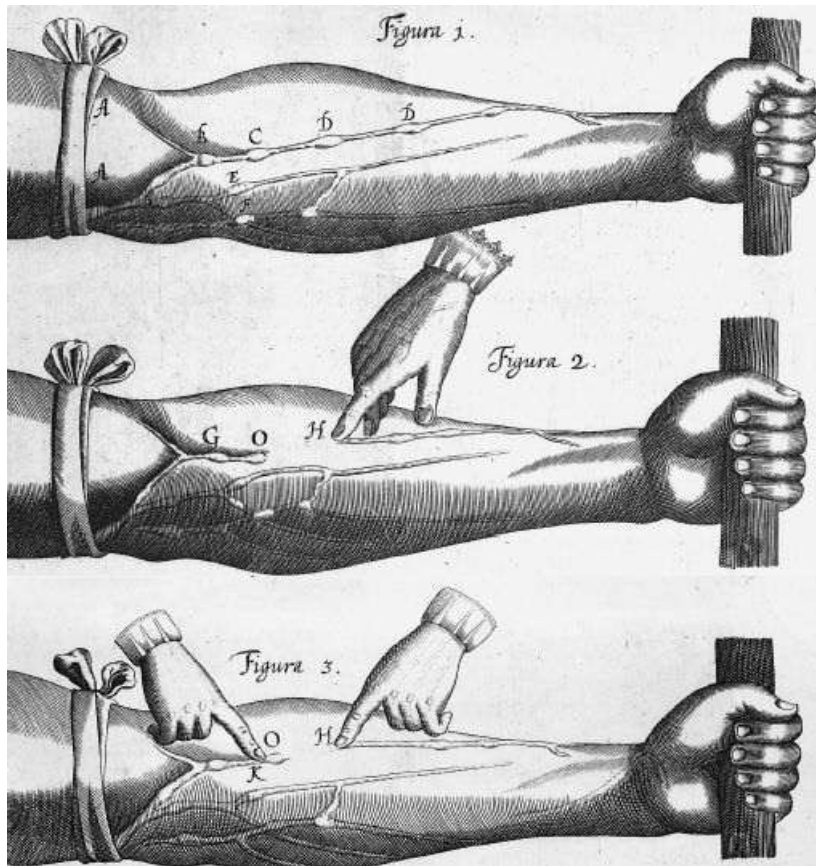


Andreas Vesalius (1514-1564)

***De homini corporis fabrica...*, 1543**
On the fabric of the human body



William Harvey (1578 –1657) and the circulation of the blood



De Motu Cordis
1628



Francis Bacon (1561-1626)

Natural Philosopher

Government Official

Lord Chancellor

Novum Organon

Great Instauration

New Atlantis

Compass, Gunpowder,
Printing

The ant, the spider, the
bee

Rene Descartes (1596-1650)



- ⊕ Descartes is often called the 'father' of modern philosophy.
- ⊕ Descartes argued that knowledge is genuinely possible, and that a mathematically-based scientific knowledge of the material world is possible.

Cogito, ergo sum

- ✦ he rejected religious authority in the quest for scientific and philosophical knowledge (but he was a devout Catholic)
- ✦ He argued for a rational justification for a universal, mathematical/ quantitative understanding of nature.
- ✦ We still rely largely on the Cartesian view of the universe – a mechanistic view of nature.

Although Descartes and other philosophers established spaces for coexistence between science and religion, it would still be quite some time before Europe would be able to embrace evolution.

Up until Darwin, the predominant understanding of the world came from the Bible and Church doctrine. In this respect, truth had been revealed (via the Bible and Christ) . . . There was no need to question God's creation

This set of beliefs meant that people were highly resistant to evidence to the contrary and even went so far to create elaborate explanations to “fit” contradictions into religious belief.

Creationism

Several compelling Christian dogmas are important to note:

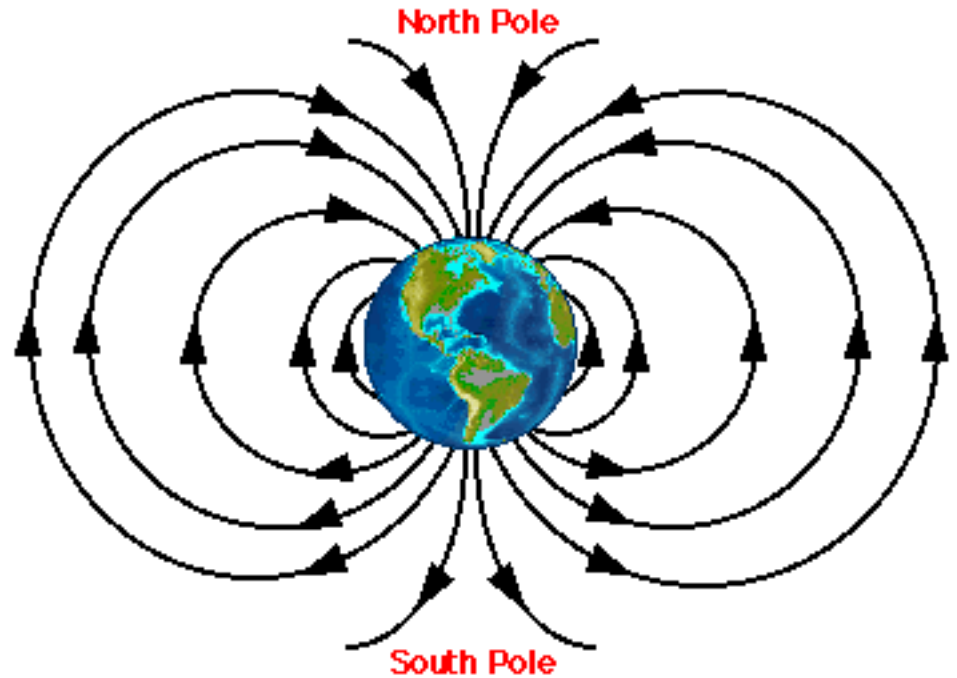
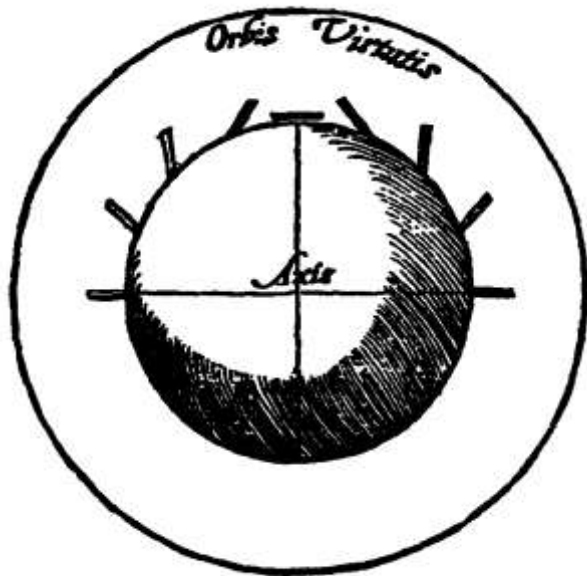
Genesis: GOD created earth in 6 days

(don't forget – he took the last day off).

Creation was also centered around Earth & Man (we are in his image).

William Gilbert

De Magnete (1600)





Galileo Galilei (1564-1642)

Kinematics and Astronomy

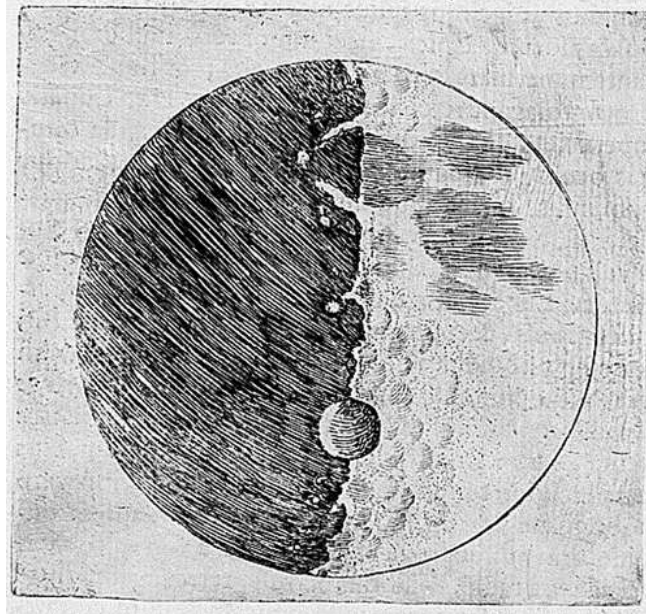
Telescope

Sunspots, Phases of Venus, Lunar craters, Moons of Jupiter, Milky way made of stars

Support of Heliocentrism

Experiments with falling bodies

Mathematics of motion





Galileo explains his discovery to the Pope



René Descartes (1596-1650)

Mathematics and Natural Philosophy

Analytic geometry

Le monde (1633)

L'Homme (1637)

Discours de la Méthode (1637)

Principia philosophia (1644)

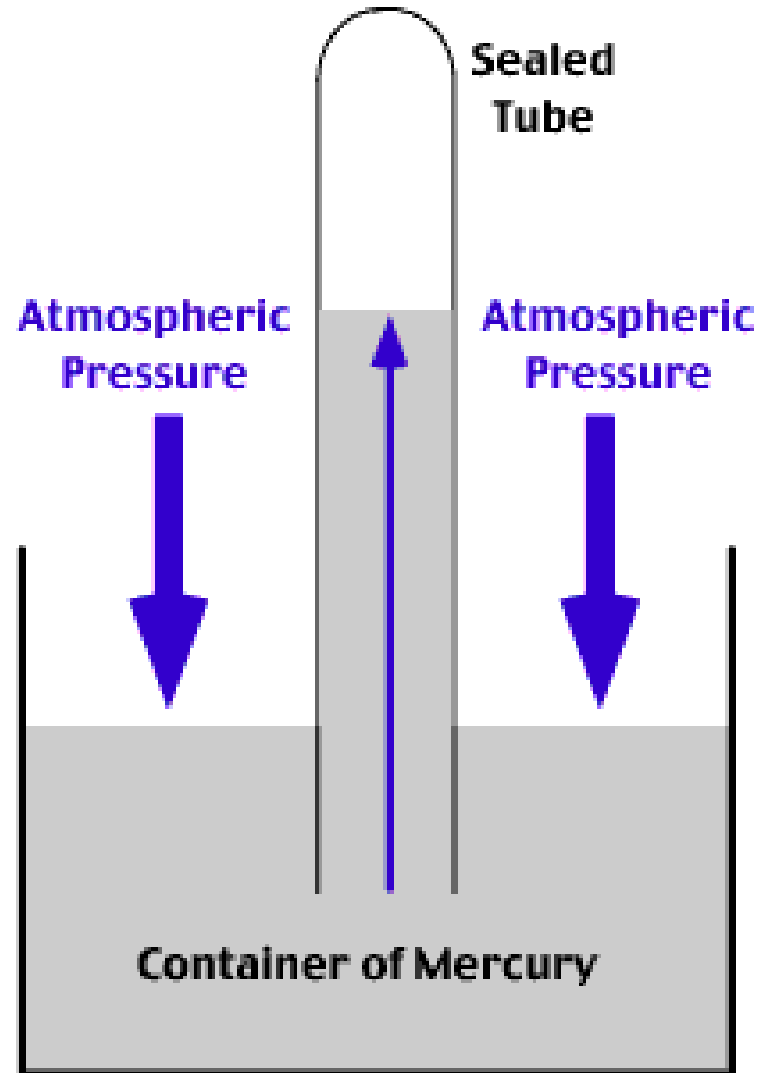
Les Passions de l'âme (1649)

Dynamics

Evangelista Torricelli's Experiment (1644)

✦ Nature does not “abhor a vacuum” and the air has weight.

✦



Blaise Pascal and Florin Périer



On September 19, 1648, Florin Périer and some friends perform the Torricelli experiment on top of Puy de Dôme in central France. The height of the mercury column is 85 mm less than in Clermont-Ferrand at the base of the mountain, about 1000 meters below.



Robert Boyle (1627-1691)

Experimental Method, Natural Philosophy

Air Pump

Skeptical Chymist (1661)

Boyle's Law

Royal Society of London

Public Verification of Science

An experiment on a bird in the air pump, by Joseph Wright





Isaac Newton (1642-1727)

Theory of Light

Theory of Motion

Theory of Gravity

Philosophiae Naturalis

Principia Mathematica

(1667)

Dynamics

Alchemy

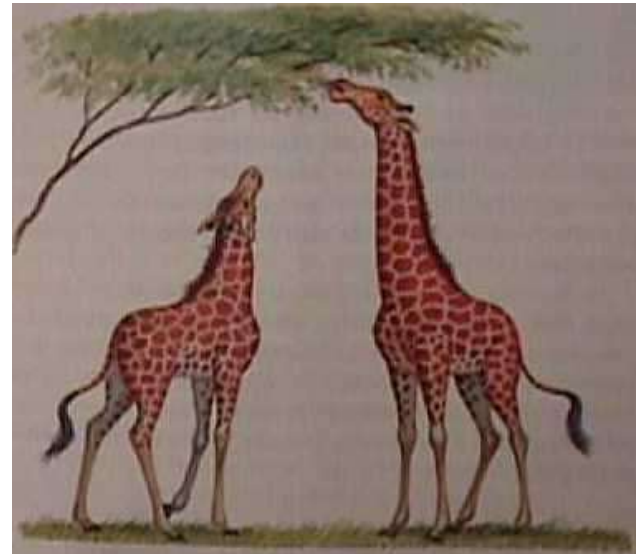
Theology

Master of the Mint

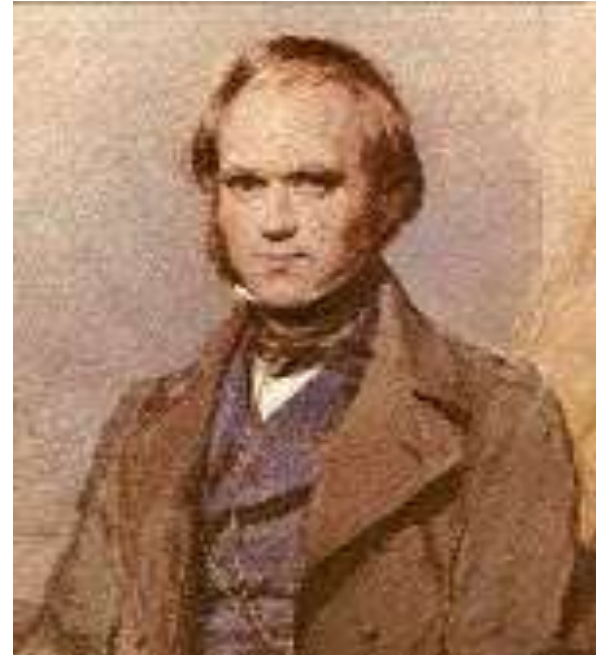
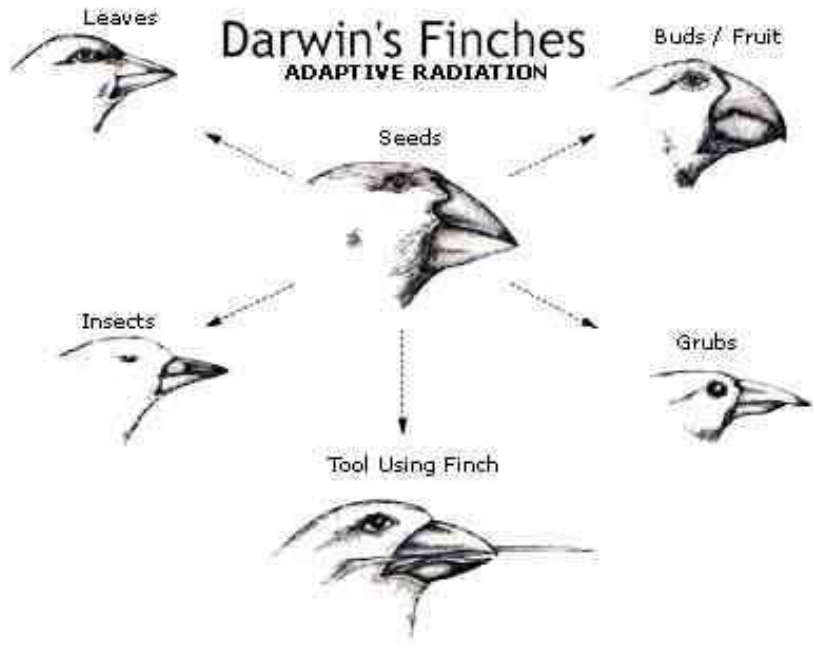
Newtonian World System

Jean-Baptiste Lamarck (1744-1829)

Inheritance of acquired characteristics



Charles Darwin



Thomas Malthus (1766-1834)

⊕ *Essay on the Principle of Population*
(1798)

⊕ In nature, organisms produce far more offspring than can survive.

⊕ Man too is capable of overproducing if left unchecked (advocated limiting family size)

⊕ Famine would become globally epidemic and eventually consume Man.



Alfred Russel Wallace

If not for me, Darwin would
not have published his ideas . .
Yet, no one remembers my
name!!



Alfred Russel Wallace (1823-1913)

- ✦ Travels to Amazon & Malay Archipelago (1848-62)
- ✦ Independently developed theory of natural selection (drew same conclusion from Malthus as had Darwin)
- ✦ Wrote an essay “On the Tendency of Varieties to Depart Indefinitely From the Original Type”
- ✦ Send ms off to Darwin for review – Darwin submitted his own, beating Wallace to the punch!!

Herbert Spencer

- ✦ **Coined the term “Survival of the Fittest”**
- ✦ **Tried to apply evolution to human populations and demonstrate moral superiority of Europeans**



Mechanical Philosophy

Natural law

Reductionistic

Mathematical

Materialistic

Anti-teleological

Inductive

Observation

Experimental method

Clockwork universe