

What the Renaissance knew

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What the Renaissance knew

- The 17th Century
 - For tens of thousands of years, humans had the same view of the universe and of the Earth.
 - Then the 17th century dramatically changed the history of humankind by changing the way we look at the universe and ourselves.
 - This happened in a Europe that was apparently imploding politically and militarily, amid massive, pervasive and endless warfare
 - Grayling refers to "the flowering of genius": Galileo, Pascal, Kepler, Newton, Cervantes, Shakespeare, Donne, Milton, Racine, Moliere, Descartes, Spinoza, Leibniz, Locke, Rubens, El Greco, Rembrandt, Vermeer...
 - Knowledge spread, ideas circulated more freely than people could travel

What the Renaissance knew

- Collapse of classical dogmas
 - Aristotelian logic vs Rene Descartes' "Discourse on the Method" (1637)
 - Galean medicine vs Vesalius' anatomy (1543), Harvey's blood circulation (1628), and Rene Descartes' "Treatise of Man" (1632)
 - Ptolemaic cosmology vs Copernicus (1530) and Galileo (1632)
 - Aquinas' synthesis of Aristotle and the Bible vs Thomas Hobbes' synthesis of mechanics (1651) and Pierre Gassendi's synthesis of Epicurean atomism and anatomy (1655)
 - Papal unity: the Thirty Years War (1618-48) shows endless conflict within Christendom

What the Renaissance knew

- Decline of
 - Feudalism
 - Chivalry
 - Holy Roman Empire
 - Papal Monarchy
 - City-state
 - Guilds
 - Scholastic philosophy
 - Collectivism (Church, guild, commune)
 - Gothic architecture

What the Renaissance knew

- Rise of
 - Umanism: glorification of the human instead of the divine
 - Pagan revival (e.g., Greek and Roman art)
 - Individualism (private enterprise)
 - Universities
 - National or regional monarchies (France, England, Spain, Russia, Firenze, Venezia, Milano)

What the Renaissance knew

- Decline of the medieval knight
 - caused by gunpowder and cannons
- Ethical code for the urban elite (vs Medieval code for the knights)
 - Baldassarre Castiglione: "Il Cortegiano" (1528)
 - Giovanni della Casa: "Il Galateo" (1556)

What the Renaissance knew

- Universities
 - Medieval universities conferred degrees that included the right to teach in any Christian country
 - Italian universities (Ferrara, Bologna, Padova) were attended by students from rich families of all Europe
 - Leiden University (Holland, 1575)
 - Geneva University (Switzerland)
 - Harvard College (USA, 1636), first university in the Americas

What the Renaissance knew

- German universities
 - Halle University (Prussia, 1691)
 - Gottingen (Hannover, 1737)
 - The seminar: emphasis on research and specialized disciplines

What the Renaissance knew

- Culture leaves the monastery - Profession of the father
 - Thomas More lawyer
 - Mikolaj Kopernik merchant
 - Michel Montaigne merchant
 - Tycho Brahe aristocrat
 - Giordano Bruno poor soldier
 - Johannes Kepler poor soldier
 - Francis Bacon aristocrat
 - Galileo Galilei musician
 - Blaise Pascal judge
 - René Descartes politician
 - Thomas Hobbes priest
 - Robert Boyle aristocrat
 - Athanasius Kircher teacher
 - Baruch Spinoza merchant
 - Isaac Newton farmer
 - John Locke lawyer
 - George Berkeley aristocrat
 - Gottfried Leibniz teacher
 - Carl von Linne priest
 - David Hume aristocrat

What the Renaissance knew

- Evolution of Reading
 - In antiquity reading was a public event: loud and for an audience
 - People shared books
 - Easy to police what people read: what you can read is limited (very few books) and everybody knows what you are reading
 - Private reading was unusual in the Middle Ages (St Augustine marvels that St Ambrose can do it)
 - Private thoughts were entrusted to letters (mystics entrust them to diaries too)

What the Renaissance knew

- Evolution of Reading
 - Printing a book has become so cheap that 1. all sorts of books are being published and 2. People can afford to buy their own copy
 - People don't share books anymore: they read in private
 - Reading becomes an intimate act, free from social constraints

What the Renaissance knew

- Evolution of Reading
 - Impossible to police what others read: too much printed material and we don't hear what others read
 - Secret thoughts can now be printed and read without too much fear
 - Women are among the most devoted solitary readers

What the Renaissance knew

- Evolution of Reading
 - The diary (Samuel Pepys, Daniel DeFoe's "Robinson Crusoe" of 1719)
 - British magazines full of letters in the 1680s
 - Letters eventually create their own literary genre, the epistolary novel
 - Lettres Portugaises (1669),
 - Aphra Behn's "Love-Letters Between a Nobleman and His Sister" (1684),
 - Montesquieu's "Lettres Persanes" (1721)
 - Samuel Richardson's "Pamela" (1740) and "Clarissa" (1749)
 - Rousseau's "Julie" (1761)

What the Renaissance knew

- National monarchies
 - England (post Wars of the Roses, 1485)
 - France (post Hundred Years War, 1453)
 - Spain (post union of Castilla and Aragon, 1469)
 - Russia (post fall of Byzantium, 1462)
 - Wittenberg University (Germany, 1502)
 - Aristocracy discredited
 - Monarchy viewed as savior of the country
 - National consciousness

What the Renaissance knew

- National monarchies/ Italy
 - Milano annexes Genova (1378)
 - Venezia annexes the Veneto (1454)
 - Firenze annexes Pisa (1406)
 - Napoli united with Sicily (1442)
 - Roma annexes Bologna (1506)

What the Renaissance knew

- National monarchies
 - The discovery of America and trade with the Indies change the nature of national conflicts: trade conflicts become progressively more important than religious or dynastic conflicts

What the Renaissance knew

- Husbandry revolution
 - New crops
 - More cattle
 - Elimination of fallowing
 - More arable land

What the Renaissance knew

- Crops from America
 - Corn/maize: more productive of calories per acre
 - Tomatoes: important source of vitamins A and C
 - Capsicum peppers (which later evolved into bell peppers and chili peppers): more vitamin A than any other food plant, and also rich in Vitamin B, more vitamin C than citrus fruits, also contain significant amounts of magnesium and iron
 - Potatoes (1588, Spain): an abundant supply of calories and nutrients (the only missing vitamins can be found in milk, vitamins A and D)
 - Cassava

What the Renaissance knew

- Crops from America
 - Most important crops of the world in 2015: wheat, corn/maize, rice, sugar cane, potato
 - Columbus restores Pangaea's unity of flora and fauna
 - Peruvian guano, the world's first intensive fertilizer (Justus von Liebig, 1840)
 - End of the great famines
 - The food supply available to Europeans more than doubles
 - Crops from America contribute to Europe's population explosion

What the Renaissance knew

- Crops from America
 - Eurasian crops do well in the New World and can be cultivated in larger quantities
 - 1516: Sugarcane transplanted by the Spanish in Santo Domingo
 - For the first time in history, there is enough sugar that it can be consumed by ordinary families
 - Quinine, which (after the Dutch establish plantations in Java in 1854) will facilitate European survival in malaria-ridden regions of Africa in the 19th century

What the Renaissance knew

- Crops from America
 - Vanilla
 - Tobacco (at first regarded and consumed only as a medicine)
 - Coca (Freud still believed that it increases creativity and stamina, and decreases hunger)
 - Cacao
 - The Spanish held a monopoly on production and trade of cacao up until the 17th century when France began cacao production in Martinique and Saint Lucia and the Dutch East Indies began cacao production in Indonesia
 - Rubber not exploited until 1770, when Charles Marie de La Condamine

What the Renaissance knew

- Syphilis
 - No medieval medical treatise mentions syphilis
 - 1493 Imported from America by Columbus crew
 - 1495 Members of the crew join the army of French king Charles VIII invading Italy
 - Troops returning to France spread it in France
 - Syphilis is the first disease discovered after the invention of printing, which means that it is the first disease to make news all over Europe

What the Renaissance knew

- Exotic vices
 - Sugar replaces honey as a sweetener (Venezia/ Venice from Cipros/Cyprus, then Portugal from Madeira 1520-16xx)
 - English imports of sugar more than double between 1663 and 1699 and the price drops 50%
 - Chocolate (1529, Spain from Mexico)
 - Coffee (1517, Venezia from Ethiopia via Arabs and Ottomans), originally marketed as a cure for many diseases
 - Coffeehouses spread in London

What the Renaissance knew

- Exotic vices
 - Tobacco (1586, England from Virginia)
 - Tobacco imports by England from the American colonies multiply 50 fold between 1619 and 1635
 - Tea (1650s, England from India)
 - Tea passes silk as the main import of the East India Company (1720s)
 - Initially tobacco, chocolate, coffee and tea are considered medicinals

What the Renaissance knew

- Genetic engineering
 - European botanists learn how to grow exotic plants in Europe
 - 1540s: Botanical gardens in Italy (mainly medicinal plants)
 - Botanical gardens in Dutch colonies and in Holland to study and transplant exotic plants
 - 1672: Paul Hermann's Ceylon Herbarium at Leiden
 - Botanists help relocated exotic plants to Europe (and also to other European colonies), closing the loop that started with explorers and colonists.

What the Renaissance knew

- Genetic engineering
 - Maize grows in soils that are too wet for wheat and too dry for rice, and produces a higher yield than any other grain
 - Botanists engineer potato varieties that are easy to grow almost anywhere
 - Potatoes become popular in the north during famines:
 - France 1709
 - Prussia 1740
 - Russia (Catherine the Great makes it compulsory to grow potatoes in order to fight the famine)
 - England 1793

What the Renaissance knew

- Genetic engineering
 - Maize and potato allow Europeans to produce much more food from the same amount of land

What the Renaissance knew

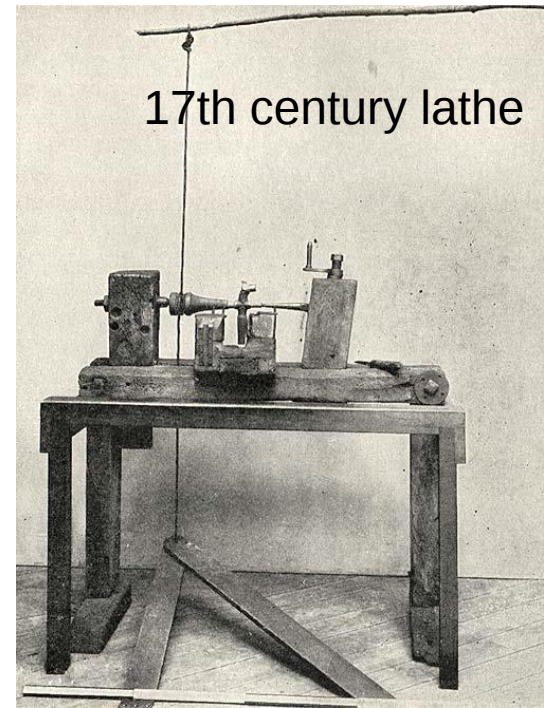
- Genetic engineering
 - European botanists learn how to grow exotic plants in Europe



English king Charles II receiving a pineapple grown in England (1675)

What the Renaissance knew

- Technological progress
 - More sophisticated waterpower and windpower
 - Widespread use of peat and coal
 - Improved blast furnaces
 - Increased mining activities and knowledge of metallurgy (Georgius Agricola's "De Metallica", beginning of geology)
 - But most machinery (e.g. lathes) still made of wood



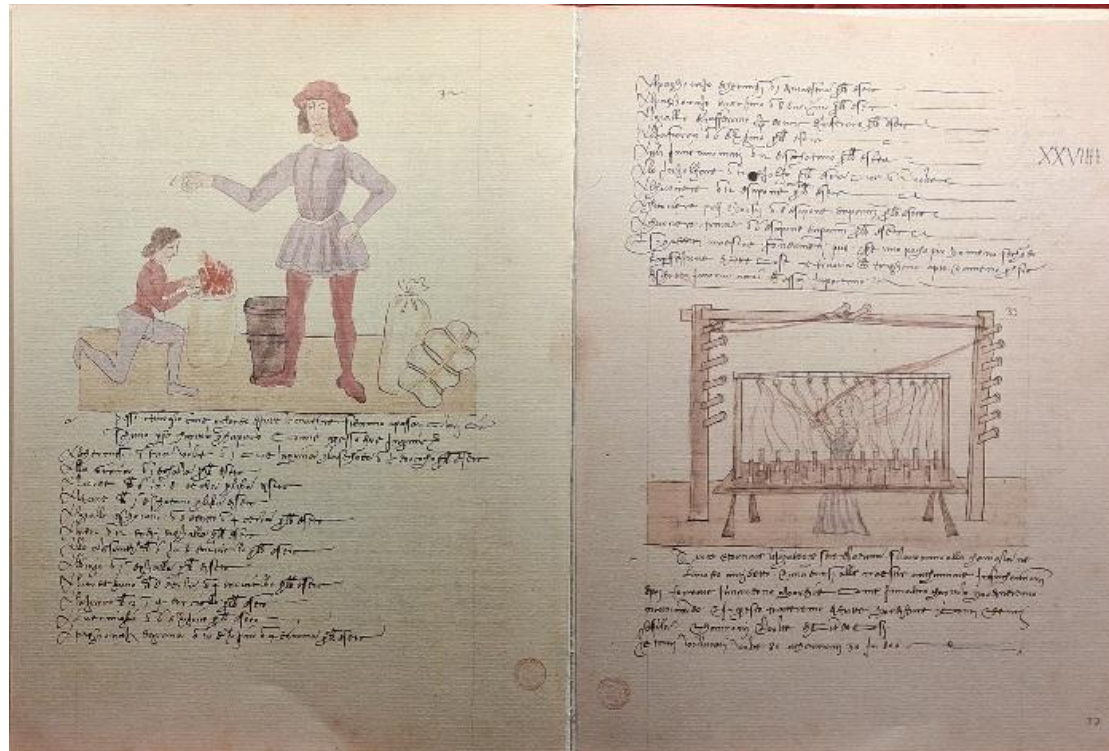
What the Renaissance knew

- Technological progress
 - Engineering literature written by engineers for engineers
 - Mariano Taccola's "De Machinis" (1449)
 - Francesco di Giorgio Martini: "Trattato di architettura, ingegneria ed arte militare" (149#)



What the Renaissance knew

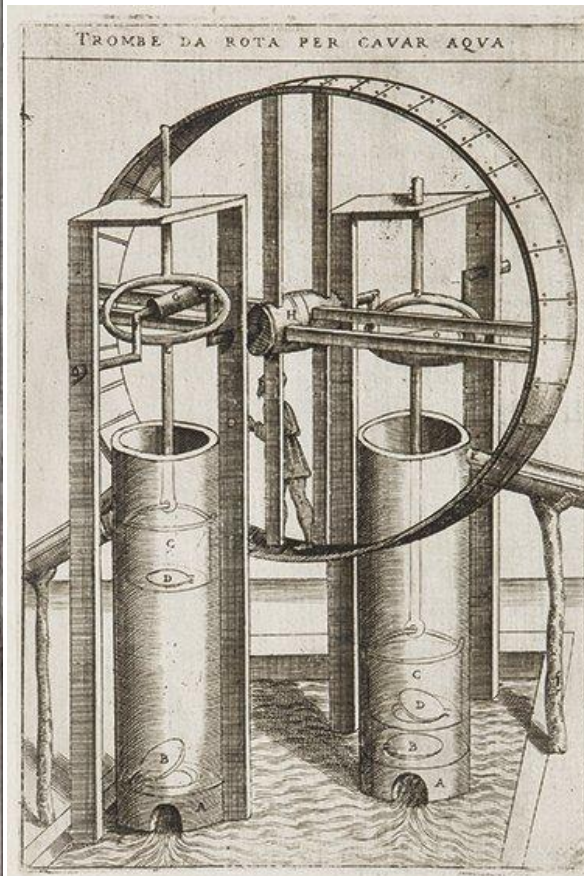
- Technological progress
 - Engineering literature written by engineers for engineers
 - "Trattato della manifattura della seta in Firenze" (1487)



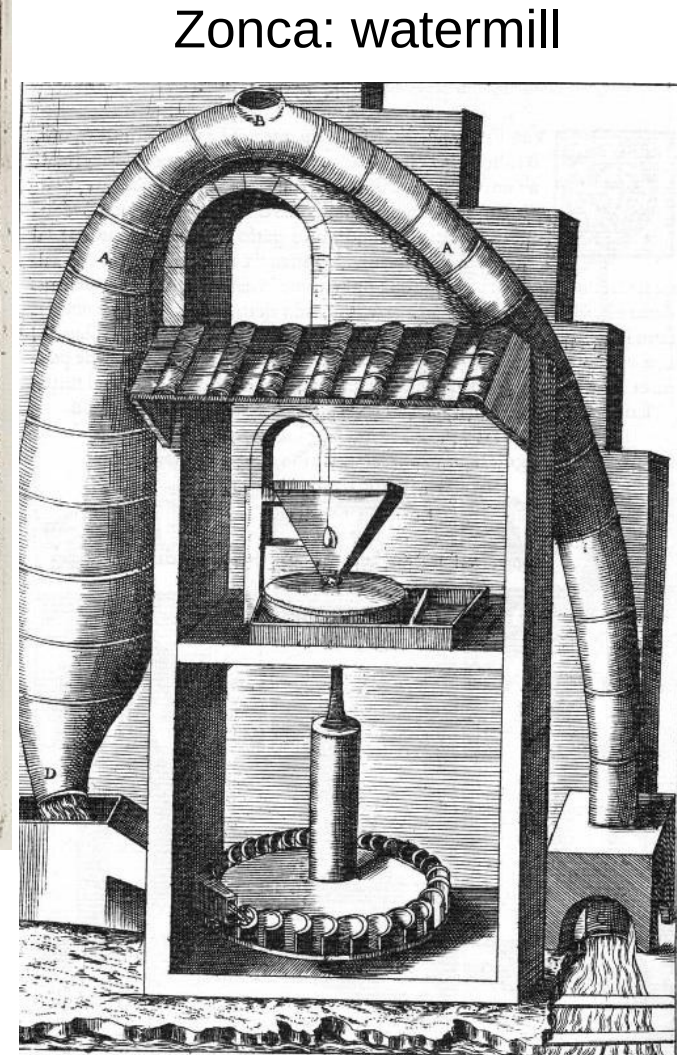
What the Renaissance knew

- Technological progress
 - Engineering literature written by engineers for engineers
 - Hyeronimus Bruschiwig's "Liber de Arti Distillandi" (1500)
 - Jacques Besson's "Theatrum Instrumentorum et Machinarum" (1569)
 - Vittorio Zonca's "Novo Teatro di Machine et Edificii" (1607)

What the Renaissance knew



Zonca: water pump



Zonca: stamping mill

What the Renaissance knew

- Technological progress

Vannoccio
Biringuccio's "De
la Pirotechnia"
(1540, first printed
book on
metallurgy
published in
Europe)

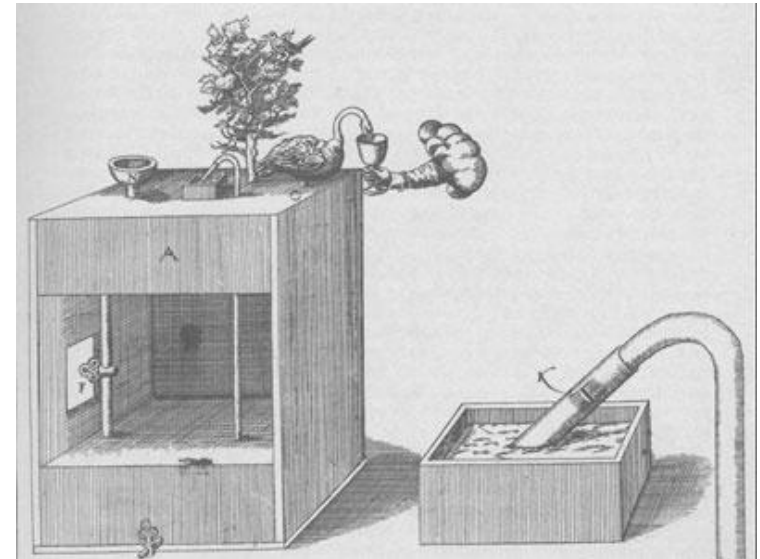
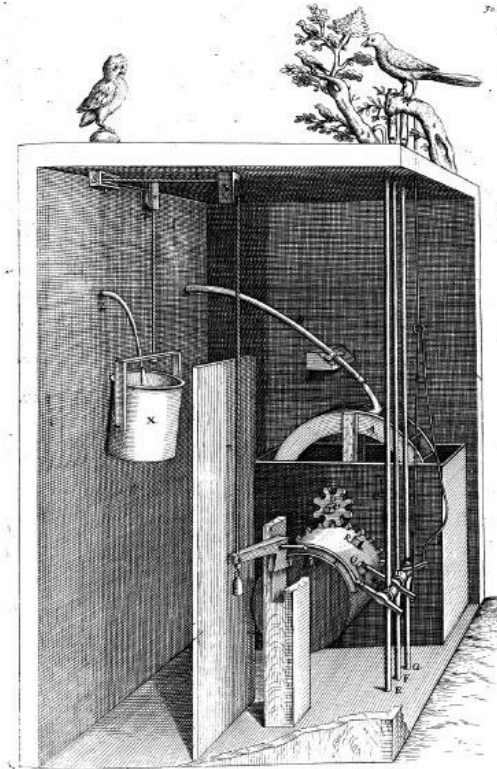


What the Renaissance knew

- Technological progress
 - Hydraulic engineering
 - Mechanical power supplies in Toledo (1526), Augsburg (1548), London (1582)
 - Progress in textile industry
 - Wooden frame (William Lee, 1589)
 - Dutch loom (1604)
 - Patent system in Venice to protect inventors (1474)

What the Renaissance knew

- Technological progress
 - Salomon de Caus (1615)



“The reasons for moving forces with various machines as useful as pleasant” (1615), a book of automata

What the Renaissance knew

- Technological progress
 - Technological progress still largely independent of scientific progress
 - Not only knowledge of nature but also control of nature
 - No major inventions but continuous widespread improvements
 - A side-effect of a new rationalist approach, but constrained by the guilds (no attempt to automate production)

What the Renaissance knew

- Technological progress
 - Engineers build civil and military architecture
 - Engineers invent and build instruments (weapons, clocks, musical instruments, maps)
 - Their knowledge is empirical, not scientific
 - Most of them cannot read Latin, they come from the lower classes and learn their skills after years of apprenticeship
 - Engineers write in vernacular because they can't write in Latin and their audience can't read Latin

What the Renaissance knew

- Technological progress
 - Humanists read Latin and Greek and rediscover ancient science
 - Engineers cannot read the classics but invent new science
 - Engineers realize the importance of mathematics in engineering

What the Renaissance knew

- Technological progress
 - See globes and navigation tools at museums/europe24/germanis.html

What the Renaissance knew

- Science
 - 1603: Accademia dei Lincei in Rome
 - 1635: the Academie Francaise in Paris
 - 1662: Royal Society in London
 - 1580: Tycho Brahe's observatory at Uraniborg
 - 1667: Paris observatory
 - 1675: Greenwich observatory

What the Renaissance knew

- Science
 - Physics:
 - Galileo Galilei
 - Tycho Brahe
 - Johannes Kepler
 - Christiaan Huygens
 - Isaac Newton
 - Edmund Halley: “Catalogus Stellarum Australium “ (1679)
 - Chemistry:
 - Henry Cavendish
 - Joseph Priestly
 - Robert Boyle

What the Renaissance knew

- Science
 - Geology:
 - James Hutton
 - Pathology:
 - Giovanni Battista Morgagni: "On the Seats and Causes of Disease" (1761)
 - Biology
 - Marcello Malpighi: "Anatomy of Plants" (1671)
 - Robert Hooke: "Micrographia" (1665)
 - Antonie van Leeuwenhoek: Letter on the protozoa to the Royal Society (1677)
 - Carl von Linne: "Systema Naturae" (1735)
 - Jan Swammerdam: "A General History of Insects" (1737)

What the Renaissance knew

- Deurbanization of industry
 - Manufacturing in cities is expensive and controlled by guilds
 - Manufacturing in the countryside is cheap and free
 - Dispersion of production sites
 - Production process broken down into discrete stages
 - Division of labor
 - Mass production
 - Decline of guilds

What the Renaissance knew

- A History of Printing
 - Egypt: papyrus
 - Rome: parchment
 - 105: Ts'ai Lun's invents paper in China
 - 793: the caliph of Baghdad establishes a paper factory
 - 983: a 250,000 page Buddhist book is printed in China
 - 1023: paper money is printed in China
 - 1041: Movable type is invented by Bi Sheng in China
 - 1155: a map is printed of western China

What the Renaissance knew

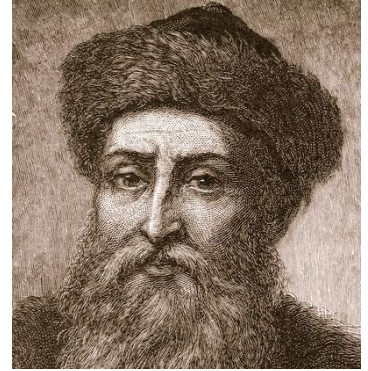
- A History of Printing
 - 12xx: paper is “invented” in Spain
 - 124x: movable type metal printing press is invented in Korea
 - 1255: a paper mill opens in Genoa
 - 1282: paper watermarks are produced in Italy
 - 1390: paper mill in Nuremberg
 - 1423: Laurens-Janszoon Koster (Netherlands) introduces movable type in Europe
 - 1450: newsletters begin circulating in Europe
 - 1456: Gutenberg “invents” the printing press

What the Renaissance knew

- A History of Printing
 - China: the large numbers of characters of the Chinese alphabet makes movable type less practical than woodblock printing
 - Arabs: the Arabic script (in which some letters connect to others) is also impractical
 - Europe: the Latin alphabet (just 20 some characters, clearly separated) is ideal for movable type

What the Renaissance knew

- Gutenberg's Printing Press (1456)
 - Typography (as opposed to the xylography widespread in Asia)
 - Based on technologies that had existed for a long time:
 - Wood block engraving
 - Raised letters (coinage)
 - Wine press
 - Paper (12th C)
 - Oil-based inks (10th century)



What the Renaissance knew

- Gutenberg's Printing Press (1456)
 - Innovations
 - Movable type (impractical for Chinese characters)
 - Alloy of 80% lead, 15% antimony and 5% tin that is soft enough to cast but hard enough to survive thousands of impressions

What the Renaissance knew

- Gutenberg's Printing Press (1456)
 - Why it took so long
 - Romans had the technology but not the paper
 - Chinese had the technology and the paper, but 800+ characters
 - Europeans had the technology, the paper and a manageable alphabet, but no motivation to print books... until the Greek exodus from Byzantium

What the Renaissance knew

- Printing Press/ Before
 - Boom of universities and commerce has greatly increased demand for books
 - Copying manuscripts is time-consuming and error-prone
 - Paper arrives from Sicily and Spain in the 12th century via the Muslims who had taken it from Samarkand, a great papermaking center
 - 1422: The library of Cambridge Univ has only 122 manuscripts

What the Renaissance knew

- Printing Press
 - First book: 210 copies of a 1282-page Bible (1456)
 - Culture shock: all copies are absolutely identical!



What the Renaissance knew

- Printing Press/ After
 - Johann Fust and Peter Schoeffer take over Gutenberg's shop
 - Mainz becomes the center for printing books
 - Each print shop is an assembly line with division of labor among specialists: lettering, binding, decoration, etc
 - Anton Koberger's Nuremberg-based firm in 1500 employed 100 craftsmen and owned 16 shops
 - 1462: An invasion causes most printers to flee Mainz and spread all over Europe

What the Renaissance knew

- Printing Press/ After
 - Johann Fust and Peter Schoeffer's innovations
 - Two-color initials (just decoration)
 - Small font (to fit more text in a page)



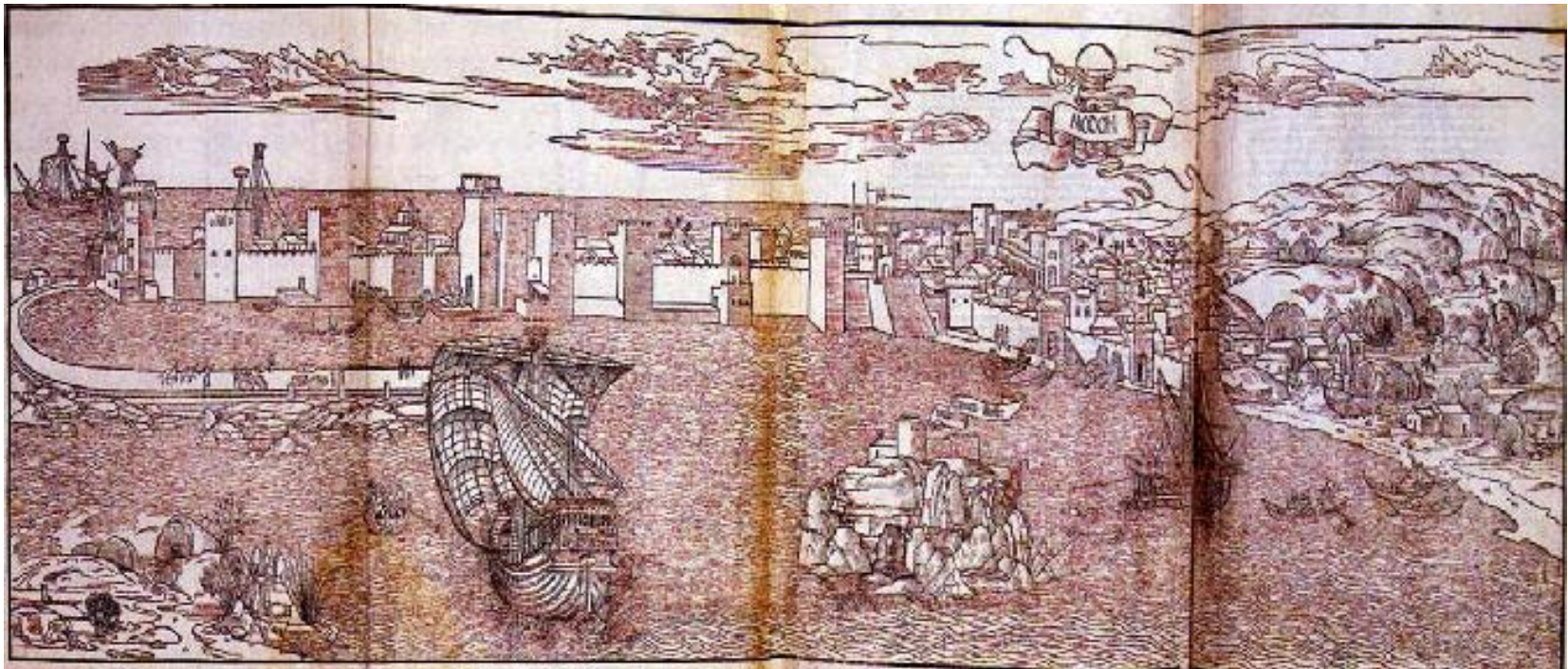
What the Renaissance knew

- Printing Press/ After
 - Woodblock illustrations since 1460 in Germany
 - Bernhard von Breydenbach's "Peregrinatio in Terram Sanctam" (1486), first printed travel book with illustrations by Reuwich Breydenbach, including the first fold-out woodcuts in Europe



What the Renaissance knew

- Printing Press/ After
 - Woodblock illustrations in Germany
 - “Peregrinatio in Terram Sanctam” (1486)



160 x 30 cm panoramic view of Venice

What the Renaissance knew

- Printing Press/ After
 - Woodblock illustrations
 - “Peregrinatio in Terram Sanctam”

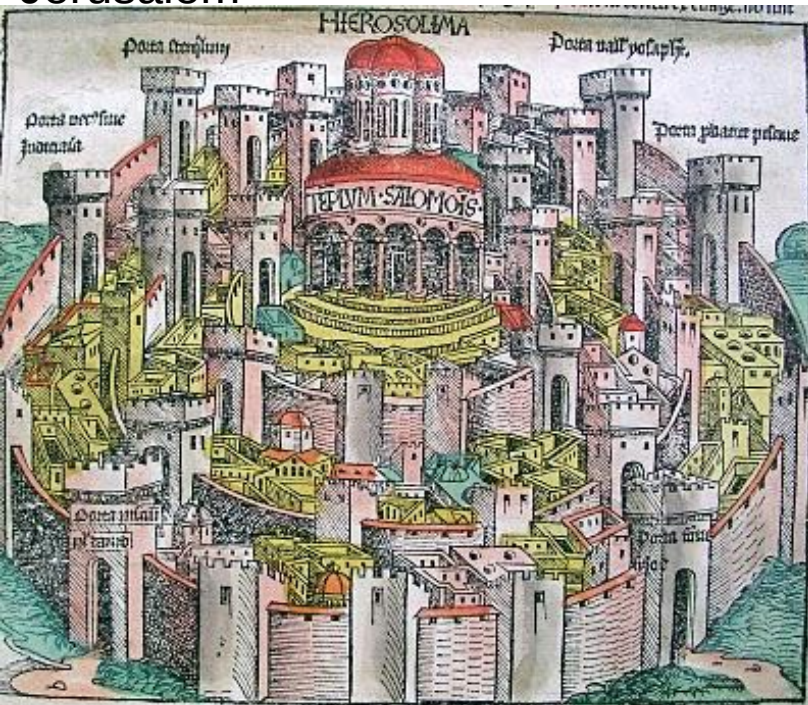


Map of the Holy Land

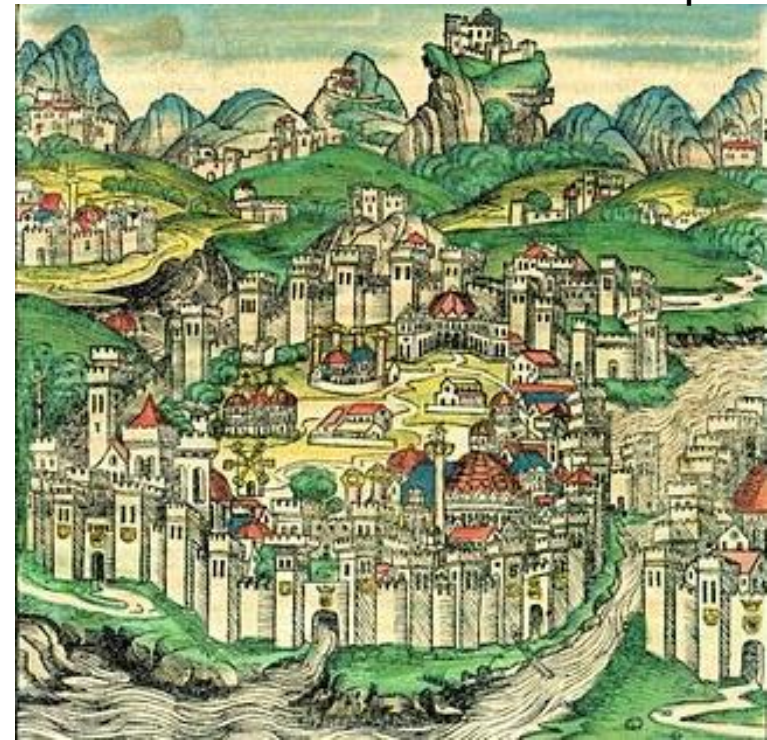
What the Renaissance knew

- Printing Press/ After
 - Anton Koberger's 1493 edition of Hartmann Schedel's "Nuremberg Chronicle" with 1809 woodcut illustrations by the workshop of Michael Wolgemut

Jerusalem



Constantinople





Nuremberg

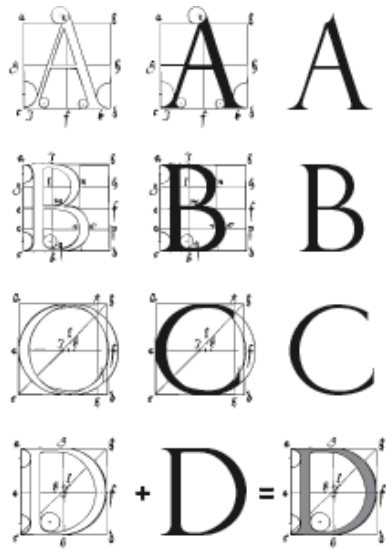


Venice

"Nuremberg
Chronicle"

What the Renaissance knew

- Woodblock illustrations in Germany
 - Albrecht Dürer/Duerer's 1498 edition of the "Apocalypse"
 - Influence of the Italian Rinascimento
 - Geometric font published in "The Four Books on Measurement" (1525)



What the Renaissance knew

- Woodblock illustrations in Germany
 - Albrecht Dürer's trivia

A 4x4 magic square with numbers arranged in a grid. The numbers are: Row 1: 16, 3, 2, 13; Row 2: 5, 10, 11, 8; Row 3: 9, 6, 7, 12; Row 4: 4, 15, 14, 1. The sum of each row, column, and diagonal is 34. The square is surrounded by a decorative border.

16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

Melancholia I copperplate engraving from 1514

What the Renaissance knew

- Printing Press
 - First printing press in Italy: 1464 (Benedictine monastery of Subiaco, Papal States, by German printers hired by the cardinal), then Ulrich Hahn in Roma (1468), Johannes de Spira in Venezia (1469)
 - First printing press in France: 1470 (Sorbonne, Paris, by German printers hired by the prior), 1472 (Lyon)
 - First in Spain: 1475 (Valencia)
 - First in England: 1476 (William Caxton in Westminster, before any paper mill existed in England: a printing press is easier to set up than a paper mill)
 - Printers belong to the bourgeois class

What the Renaissance knew

- Printing Press
 - 1573: Christophe Plantin prints the Polyglot Bible for Felipe II of Spain

What the Renaissance knew

- Printing Press
 - By 1480 every major city in Europe has a press
 - 23 in Northern Europe
 - 31 in Italy
 - 7 in France
 - 6 in Iberia
 - 1 in England
 - First printing press in America: 1539 (Mexico, commissioned by the archbishop)

What the Renaissance knew

- Printing Press
 - By 1501 there are 1000 printing shops in Europe, which had produced 35,000 titles and 20 million copies.
 - Before the press: 50,000 books in all of Europe, mostly controlled by the Church

What the Renaissance knew

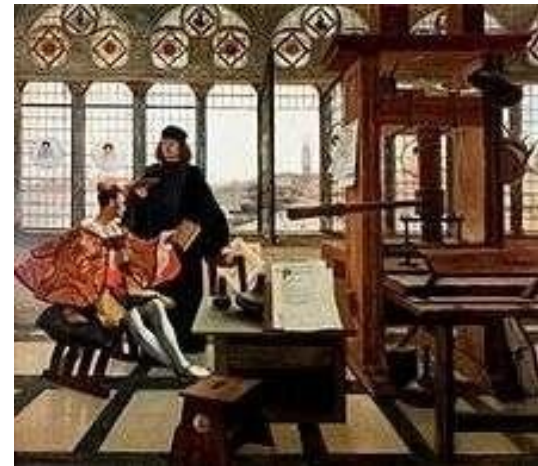
- Printing Press/ Italy
 - Firenze scorns printing as inferior to manuscripts
 - Venezia imports printers: Johannes de Spira (from Mainz, 1469), Nicolas Jenson (from France, 1471), Erhard Ratdolt (from Augsburg, 1476)
 - Emphasis on elegance and legibility
 - Page numbers, title page

What the Renaissance knew

- Printing Press/ Italy
 - 1453: Constantinople falls to the Muslims and many Greek scholars seek refuge in Italy
 - Venezia printing capital of Europe: 2,789 titles by 1500
 - 77% in Latin
 - 45% religious

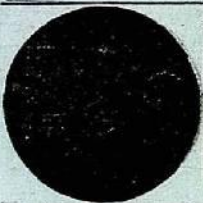
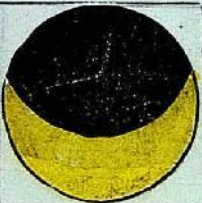
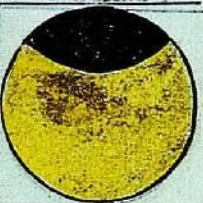
What the Renaissance knew

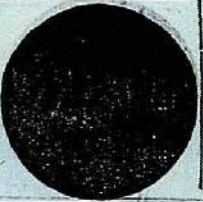
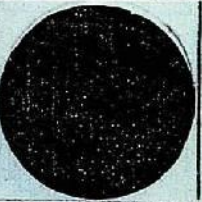
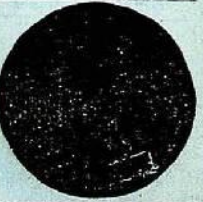
- Printing Press/ Italy
 - 1495: Aldus Manutius (Aldo Manuzio)'s press (Venezia, 1493) specializes in printing Greek and Roman classics and establishes the typographic standard for the next two centuries and prints small portable books (“formato in ottavo”) in Francesco Griffo 's italics font
 - The book becomes cheaper, easier to handle and transport, and easier to read

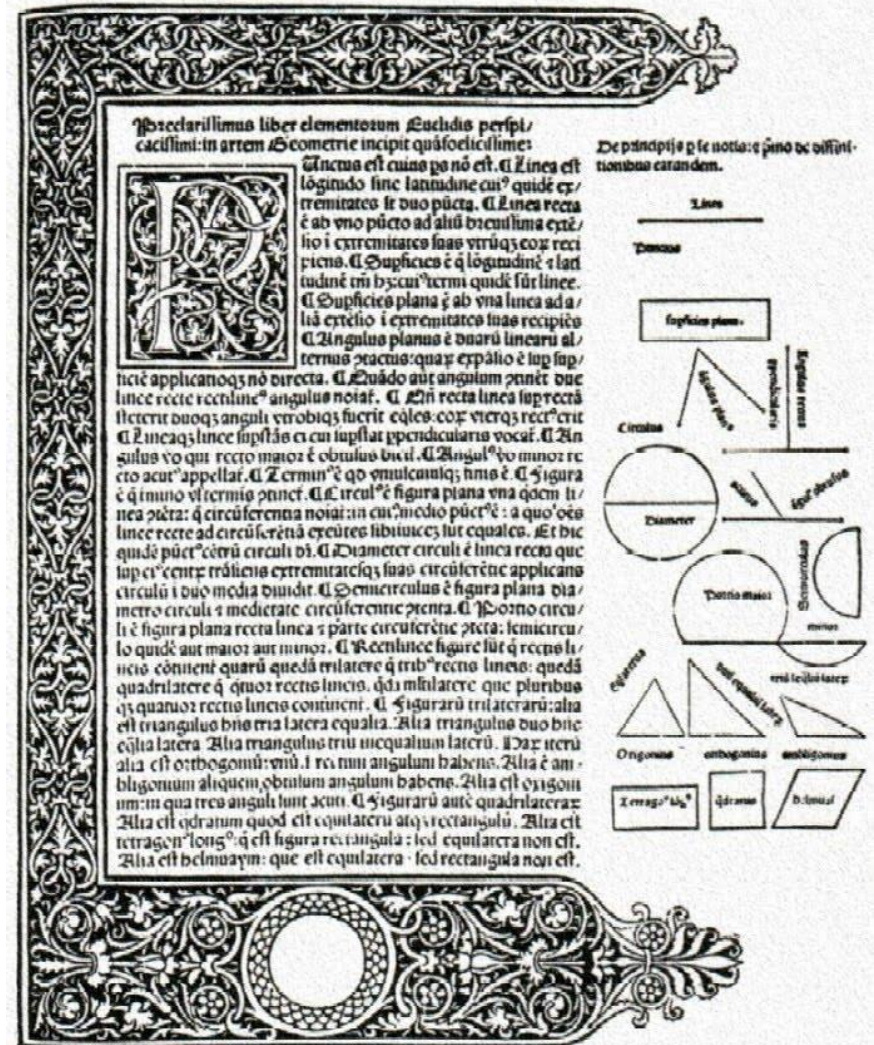


Aldus by François Flameng

What the Renaissance knew

1493	1493	1498
Eclipsis Lune	Eclipsis Solis	Eclipsis Solis
1 13 48	10 2 38	A 2 12
Aprilis	Octobris	Martii
Dimidia duratio	Dimidia duratio	Dimidia duratio
21 219	15 1 2	0 22
	Puncta octo	Puncta quatuor
		

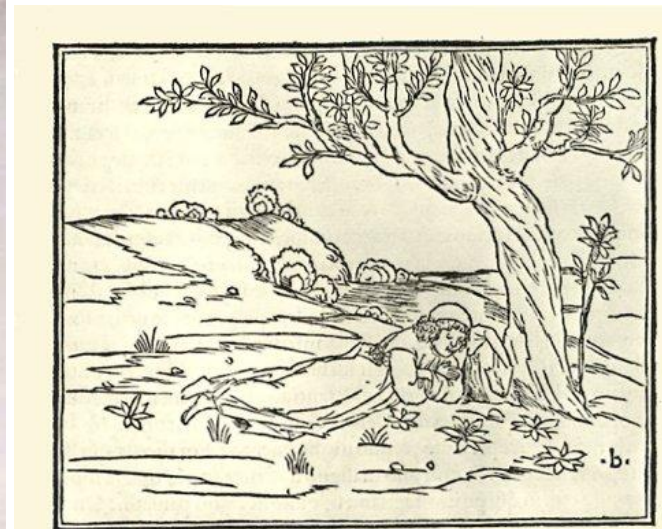
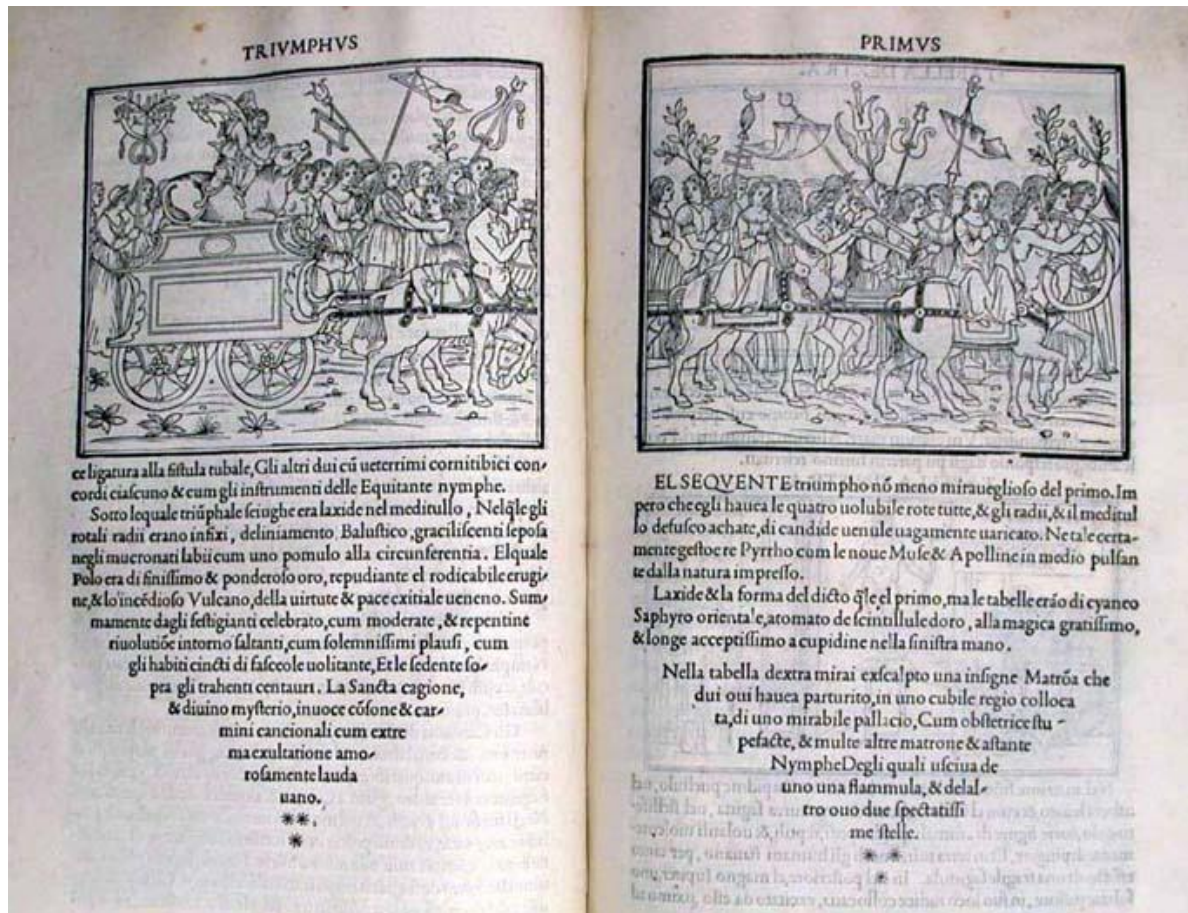
1498	1498	1498
Eclipsis Lune	Eclipsis Lune	Eclipsis Lune
21 12 38	12 17 24	18 6 38
Martii	Septembris	Ianuarii
Dimidia duratio	Dimidia duratio	Dimidia duratio
21 126	1 1 28	A 1 26
	Puncta octo	Puncta octo
		



Erhard Ratdolt's edition of Regiomontanus' "Calendarium" (1476)

Erhard Ratdolt's edition of Euclides' 69 "Geometriae Elementa" (1482)

What the Renaissance knew



POLIPHILLO QVIVI NARRA, CHE GLI PAR VE AN-
CORÀ DI DORMIRE, ET ALTRONDE IN SOMNO
RITROVARSE IN VNA CONVALLE, LAQVALE NEL
FINEER A SERATA DE VNA MIR ABILE CLAVSURA
CVM VNA PORTENTOSA PYRAMIDE, DE ADMI-
RATIONE DIGNA, ET VNO EXCELISO OBELISCO DE
SOPRA LAQVALE CVM DILIGENTIA ET PIACERE
SVBTILMENTE LA CONSIDEROE.

IA SPAVENTEVOLE SILVA, ET CONSTI-
pato Nemore euaso, & gli primi altri lochi per el dolce
somno che se hauea per le fesse & prostrinate mēbre dif-
fuso relictū, me ritrouai di nouo in uno piu delectabile
sito assai piu che el præcedente. Elquale non era de mon-
ti horridi, & crepidinose rupe intorniato, ne falcato di
strumosi iugi. Ma compositamente de grate montagniole di non tro-
po altecia. Siluose di giouani quercioli, di roburi, fraxini & Carpi-
ni, & di frondosi Esculi, & Illice, & di teneri Coryli, & di Alni, & di Ti-
lie, & di Opio, & de infrutuosu Oleastri, disposti secondo laspecto de
gli arboriferi Colli, Et giu al piano erano grate siluule di altri situatici

Aldus Manutius's edition of Colonna's
"Hypnerotomachia Poliphili" (1499)

What the Renaissance knew

- Printing Press
 - After the press
 - 1534: first Frankfurt Book Fair
 - 1545: Venezia introduces author's copyrights
 - 1566: the first newspaper, Notizie Scritte, in Venezia
 - 1571: Pope Paul IV issues Index of Forbidden Books
 - 1599: 10,000,000 books in Europe
 - End of the Church's monopoly on books (and knowledge)

What the Renaissance knew

- Printing Press
 - Spreading of humanism throughout Europe
 - Spreading of Lutheran ideas (Luther's protest used the new technology)
 - Spreading of bourgeois ideas
 - Spreading of vulgar languages (Latin remains for church and officials)
 - Spreading of national identity (the printing press as the voice and the consciousness of the people who speak the same language)
 - Translators and dictionaries

What the Renaissance knew

- Printing Press
 - First revolution in information technology (first in the chain that would lead to the telegraph, telephone, computer, Internet)
 - Faster, cheaper and more accurate diffusion of knowledge, news, etc (eg Luther's theses of 1517)
 - Destruction of the unified Latin culture of Europe

What the Renaissance knew

- Printing Press
 - Literacy becomes valuable because books are not longer difficult to find
 - As ordinary people become literate, a market is created for “pop culture”
 - Education can now rely on books at home or at the library and not depend on the presence of the tutor in the classroom (education becomes more private and less public)

What the Renaissance knew

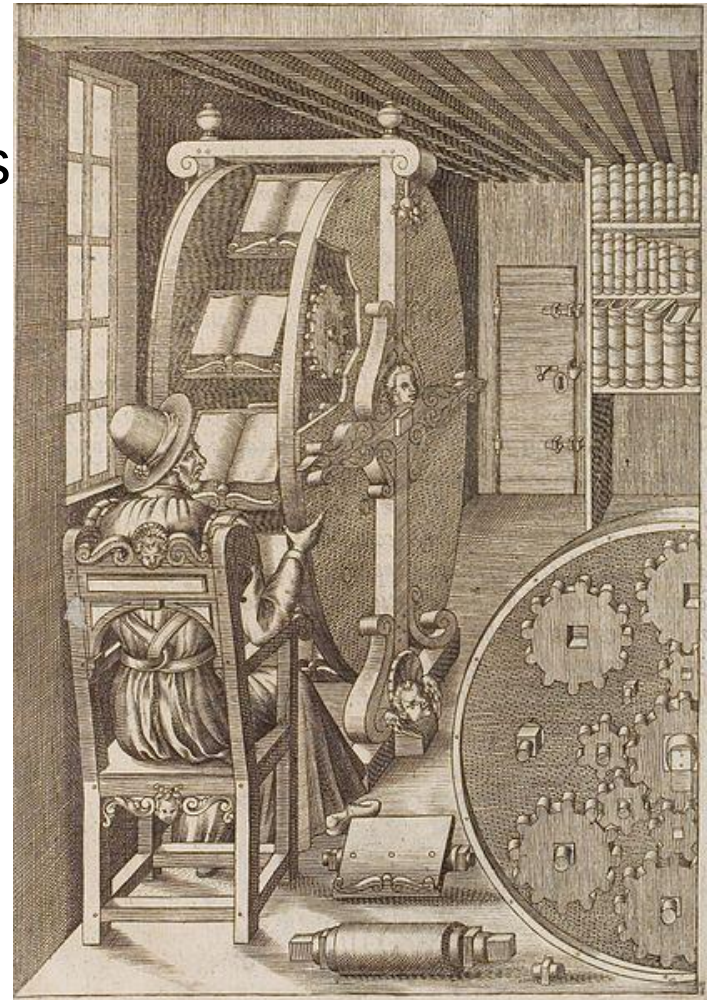
- Printing Press
 - The printed book is the first item that can be mass-produced: many exact copies of the original
 - The printing press in assembly line of movable types
 - The first mechanization of a skilled handicraft
 - The first process of homogenization of culture

What the Renaissance knew

- Printing Press
 - What increased the production of books was not the printing press per se, but the "invention" of paper, that replaced the expensive vellum.
 - The limit to the mass production of books remained the same: the fact that there was no demand for massive amounts of books, since there were very few people who could read them.

What the Renaissance knew

- Reading
 - 1588: Agostino Ramelli invents "rotary reading desk"



What the Renaissance knew

- Publishing
 - Authors don't make money from books, but they want as many readers as possible
 - Even after the invention of the printing press, many famous writers circulate their books in manuscript form (Philip Sydney, John Donne) for a restricted audience

What the Renaissance knew

- The Nuremberg Chronicle (1493)
 - Apex of xylography
 - A pictorial history of the earth from creation
 - Compiled by Hartmann Schedel
 - Illustrated and engraved by Michael Wohlgemuth, Wilhelm Pleydenwurff and Albrecht Dürer
 - First instance of partnership between artists and patrons

What the Renaissance knew

- The first newspaper
 - “Avisa Relation oder Zeitung” (Augsburg, 1609)



What the Renaissance knew

- Language
 - Latin loses its position as the universal language of learned scholars
 - Nicole Oresme writes in French
 - Luca Pacioli writes in Italian
 - Paracelsus writes in German
 - Albrecht Duerer writes in German
 - Stevin writes in Dutch
 - Giordano Bruno writes in Italian
 - Galileo Galilei writes in Italian
 - Sperone Speroni: "Dialogo della Lingua" (1547)

What the Renaissance knew

- Public opinion
 - 16th c: Coffee spreads in the Arab world
 - 1640: Coffeehouse in Venezia/Venice
 - 17th c: Coffeehouses spread in Europe
 - 1652: Pasqua Rosee opens the first coffeehouse in London
 - 1686: The first coffeehouse in Paris, Cafe' Procope
 - The coffeehouse becomes the place for discussing the news

What the Renaissance knew

- Public opinion
 - 1609: “Avisa Relation oder Zeitung” (Augsburg), the first newspaper
 - 1621: Thomas Archer publishes the first periodical pamphlet in England
 - 1631: Theophraste Renaudot's newspaper "Gazette de France", a state monopoly of the French monarchy
 - 1641: The English parliament abolishes the Star Chamber, which, among other things, was enforcing censorship in the printed matter
 - Boom in England of satirical and political pamphlets
 - 1642: 4,000 books are printed in England
 - 1644: John Milton's "Areopagitica" defends freedom of the press
 - 1653: Oliver Cromwell reestablishes control of the press

What the Renaissance knew

- Public opinion
 - 1657: Galileo students found the Accademia del Cimento in Firenze
 - 1660: England establishes the post office
 - 1662: The Royal Society of Science is founded in England
 - 1665: French lawyer Denis de Sallo starts in Paris the Journal des Scavans, the first academic journal
 - 1665: Charles II's government starts the Oxford Gazette, later renamed London Gazette, the first English newspaper
 - 1665: German theologian Henry Oldenburg, secretary of the Royal Society in London, starts the Philosophical Transactions of the Royal Society, the first peer-review journal
 - 1666: The French Academy of Sciences

What the Renaissance knew

- Public opinion
 - 1677: Jean-Alexandre de la Font starts abroad the newspaper La Gazette de Leyde, that provides independent news to the French public
 - Fake news: 1678: Titus Oates uses a book to spread false rumors about a Catholic conspiracy to assassinate king Charles II in order to stir up anti-Catholic phobia
 - 1680: William Dockwra establishes the Penny Post to deliver mail in London, but there are no home addresses so many individuals receive mail at the nearby coffeehouse
 - 1689: John Locke's "Two Treatises of Government"
 - 1690: Boston printer Benjamin Harris starts the Public Occurrences in Boston, the first newspaper of North America

What the Renaissance knew

- Public opinion
 - 1695: Censorship is lifted in England
 - A wave of periodicals in England: Defoe's "Review", Swift's "Examiner", Richard Steele's & Joseph Addison's "Spectator" (1711)

What the Renaissance knew

- Libraries
 - Library of the Escorial (1584)
 - Mazarin library in Paris
 - Leibniz's Ducal Library of Wolfenbuettel

What the Renaissance knew

- Camera obscura
 - Giovanni Battista dalla Porta's "Natural Magic" (1558, but he never built one)
 - Used by painters to solve the problem of perspective



What the Renaissance knew

- Art of Memory and Occult Philosophy
 - Marsilio Ficino's anthology of ancient "hermetic" Greek texts: "De potestate et sapientia Dei" or "Corpus Hermeticum" (1471)
 - Jacobus Publicius: "Ars Memorativa" (1482), first printed treatise on the Art of Memory
 - The spheres of the universe as a memory system
 - Pietro da Ravenna: "Fenix" (1491)

What the Renaissance knew

- Art of Memory and Occult Philosophy
 - Johann Host von Romberch: "Congestorium artificiose memoriae" (1520)
 - The spheres of the universe as a memory system
 - How to memorize ALL knowledge
 - Cornelius Agrippa: "De philosophia occulta" (1533)
 - Cosmas Rosselius: "Thesaurus Artificiosae Memoriae" (1579)

What the Renaissance knew

- Occult Philosophy/ Faust syndrome
 - John Dee: “Monas Hieroglyphica” (1564)
 - Edward Kelley: “The Book of Dunstan” (1583)
 - Heinrich Khunrath : “Amphitheater Sapientiae Aeternae” (1595)
 - Simon Studion: “Naometria” (1604)
 - Johann Andreae: “Fama Fraternitatis of the Meritorious Order of the Rosy Cross (1612), manifesto of Rosenkreuz’s Protestant cult (that causes panic in France in 1623)

What the Renaissance knew

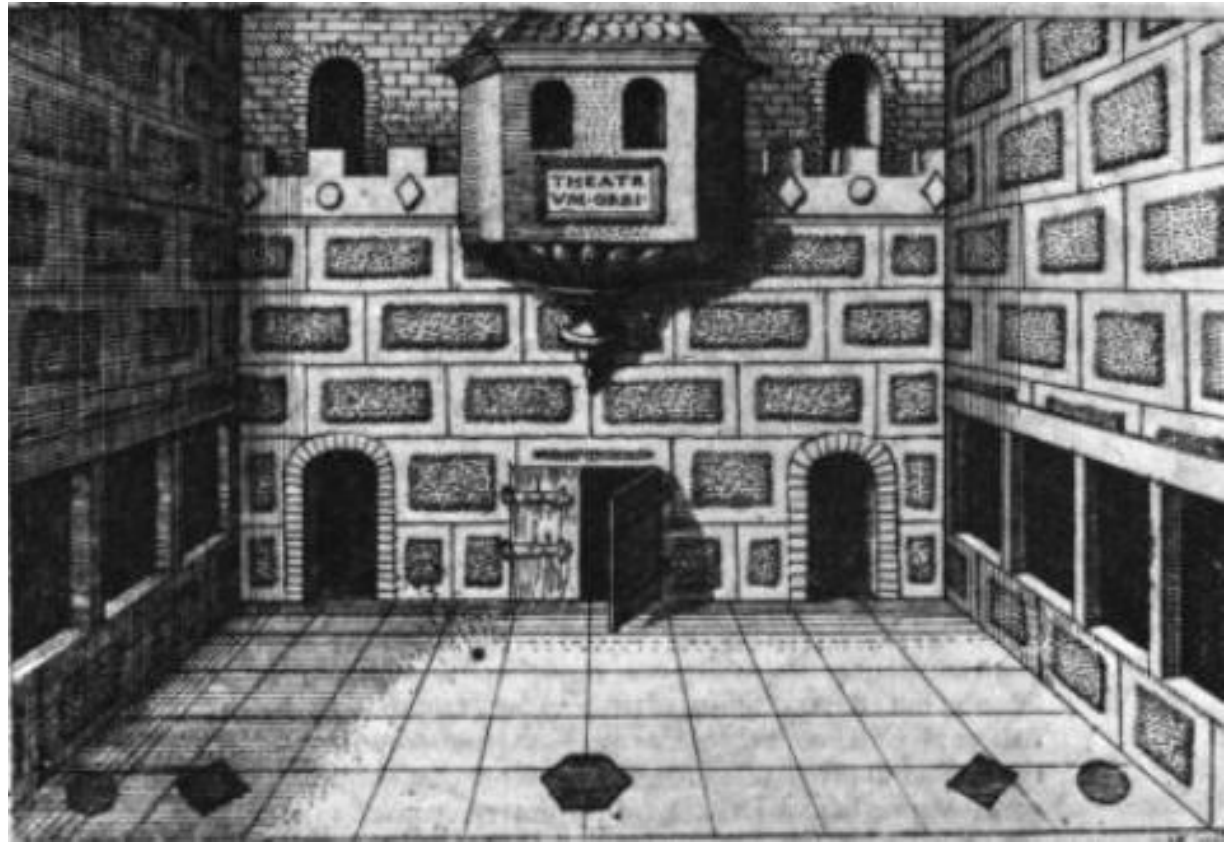
- Art of Memory and Occult Philosophy
 - Giulio Camillo Delminio: "L'idea del Teatro" (published posthumously in 1550)
 - occult philosophy and art of memory (Corpus Hermeticus and Kabala)
 - architecture and art of memory
 - Giordano Bruno: "De Umbris Idearum" (1582)
 - James Robert Fludd: "Utriusque Cosmi Maioris Salicet et Minoris Metaphysica" (1619)

What the Renaissance knew

- Alchemy and Occult Philosophy in Science
 - Pico della Mirandola
 - Isaac Newton
 - Paracelsus

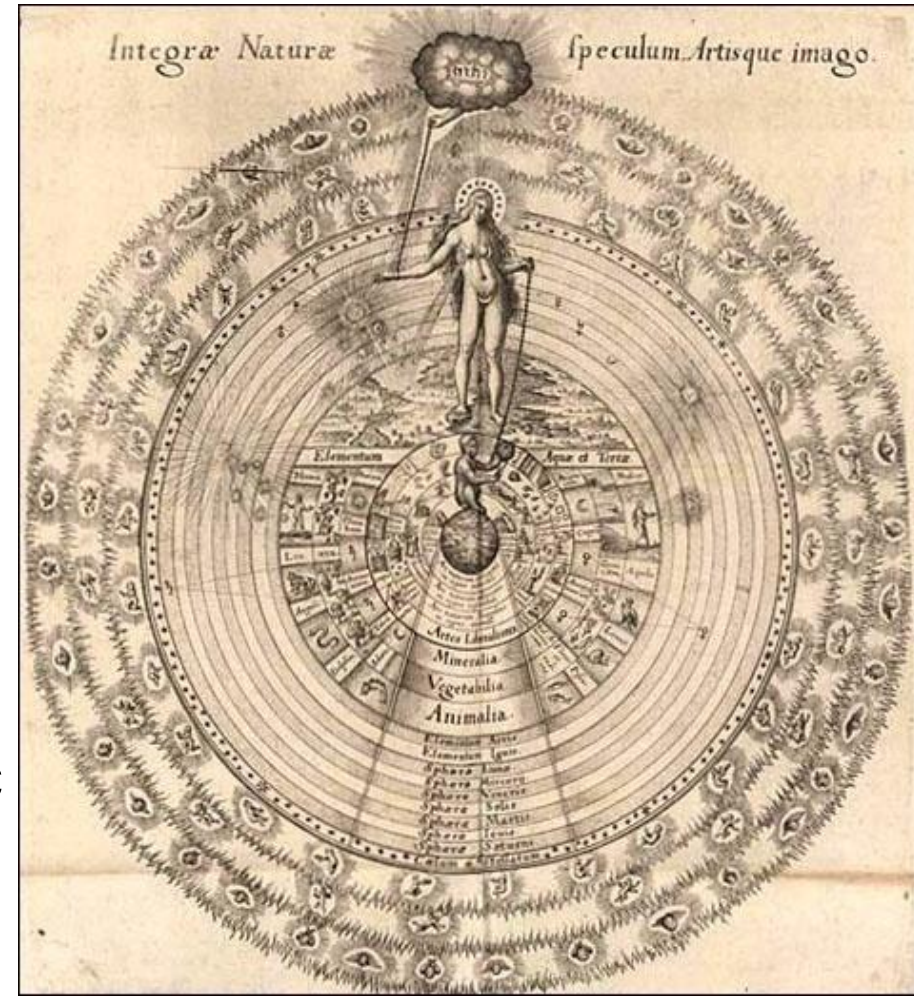
What the Renaissance knew

- Art of Memory and Occult Philosophy
 - Robert Fludd



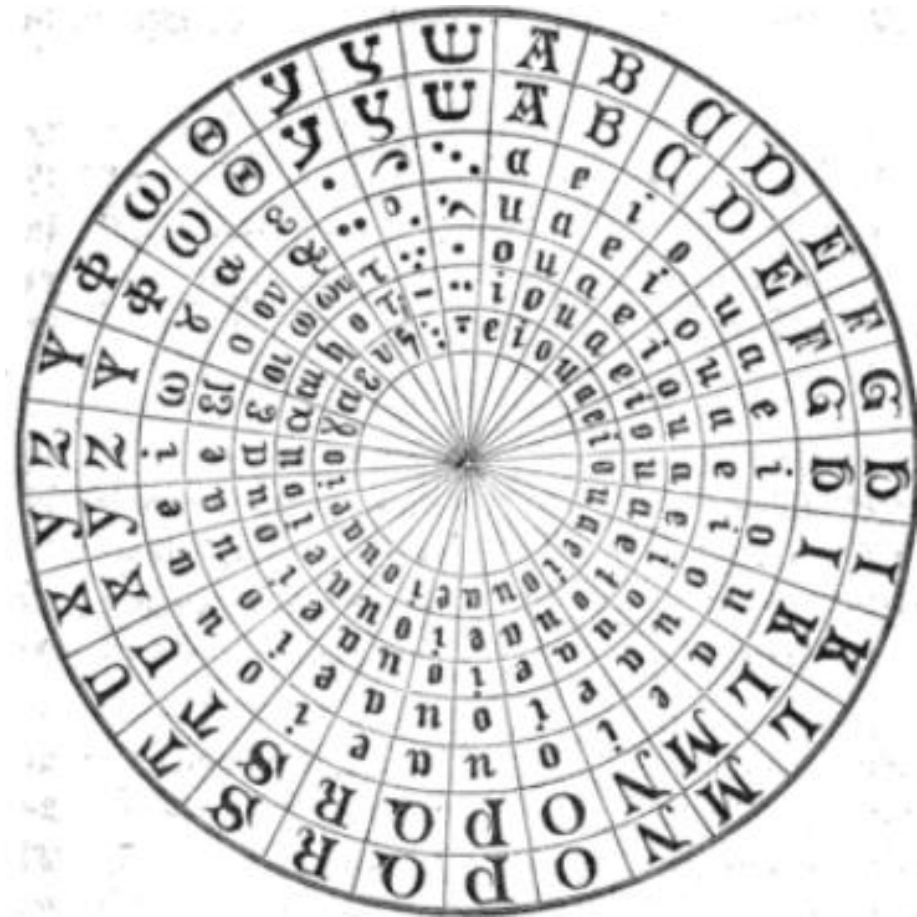
What the Renaissance knew

- Robert Fludd's "Urtriusque Cosmi" (1624)
 - Inspired by Paracelsus
 - Pantheism (God as the all-pervading form of which the world and humans are manifestations)
 - The dualism of light and darkness is inherent in all things
 - Divine proportional relationships between the cosmos, the Earth and music



What the Renaissance knew

- Art of Memory and Occult Philosophy
 - Giordano Bruno



What the Renaissance knew

- Note: more likely to be imprisoned, tortured and executed if you are a scientist than if you practice magic, alchemy and cabala
 - Giordano Bruno (burned at the stake in 1600)
 - Giuliocesare Vanini (burned at the stake in 1619)
 - Galileo Galilei (trial in 1633)

What the Renaissance knew

- Public Life
 - Elaborate aristocratic entertainment in Venezia, Firenze, Milano
 - Choreographies of horsemen
 - Masked allegorical ballets and pantomime performances
 - Social dances that emphasize etiquette



The Della Catena Map of Florence (~1471-82)

What the Renaissance knew

- Birth of Private Life
 - During the middle ages there was no difference between public and private life
 - Work, leisure and family were mixed
 - The family was an economic unit
 - In the Renaissance the public and private sphere begin to separate

What the Renaissance knew

- Birth of Private Life
 - New attitudes towards one's body and the body of others: creation of the private sphere
 - Modesty
 - The family becomes also an emotional center
 - The education of children becomes a goal of family life

What the Renaissance knew

- Birth of Private Life
 - The bureaucratic state regulates public life, thus enabling private life
 - Private life is a by-product of the bureaucratic state
 - Birthplace of privacy: England
 - Protestants' individual piety vs Catholics' collective piety
 - Side-effect of literacy: reading becomes a private experience

What the Renaissance knew

- Birth of Private Life
 - The Self:
 - Intimate memoirs (diary, letters, autobiographies)
 - Self-portrait
 - Relationship between reading, writing and self-understanding
 - Solitude is sought after

Velasquez: The Toilet of Venus (1650)



What the Renaissance knew

- Birth of Private Life
 - Dichotomy civilized vs barbarian
 - Etiquette of the court spreads to the whole of society
 - The chivalry ideals of the Middle Ages are transplanted into the etiquette of the masses
 - Table manners
 - Good taste in food
 - Boarding schools to educate children to civilized manners

What the Renaissance knew

- **Birth of Private Life**



Pieter Bruegel d. J. "The Visit to the Farm"

What the Renaissance knew

- Marsilio Ficino (b1433)
 - 1462: found the Platonic Academy in Firenze
 - “Platonic love”

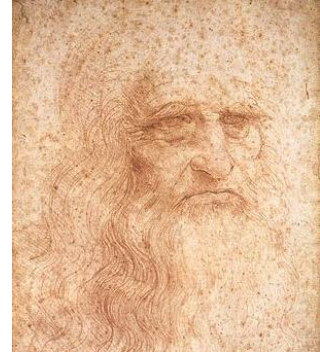
What the Renaissance knew

- Pico della Mirandola (b1463)
 - Oration on the dignity of man
 - Tries to reconcile all religions and philosophies
 - Opposed to astrology (the heavens neither cause nor herald events on Earth)

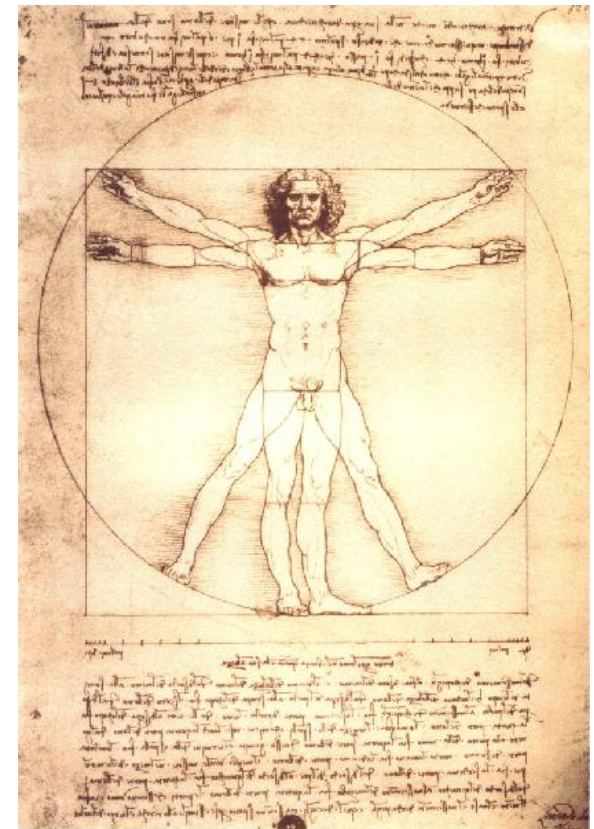
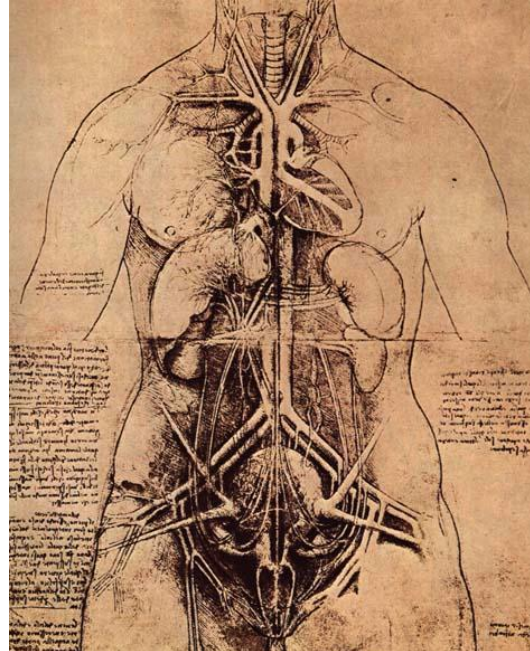
What the Renaissance knew

- Lorenzo Valla: pointless to die for one's homeland
- Pietro Pomponazzi: the universe must be interpreted in terms of cause and effect
- Niccolo Machiavelli (1532)
 - Cynicism: no moral law for rulers
 - Human action is driven exclusively by self-interest
 - A state either expands or decays

What the Renaissance knew



- Leonardo da Vinci (b1452)
 - Perspective
 - Art and Science
 - Pacifism

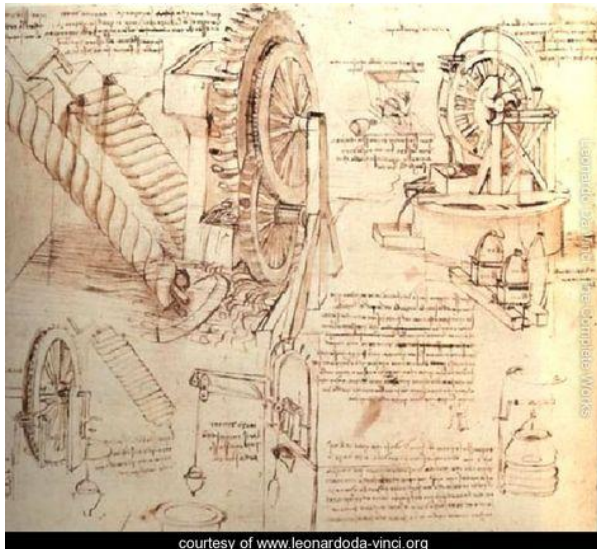
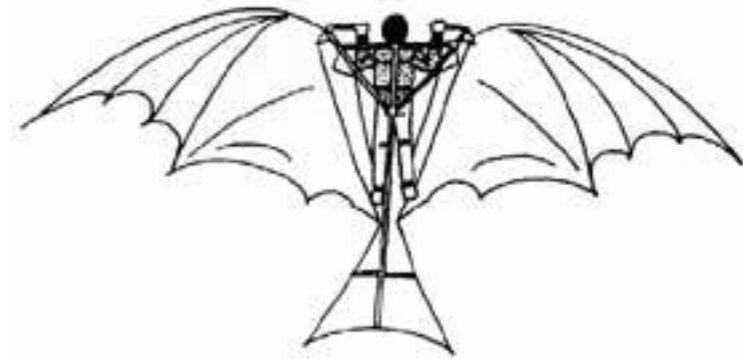


What the Renaissance knew

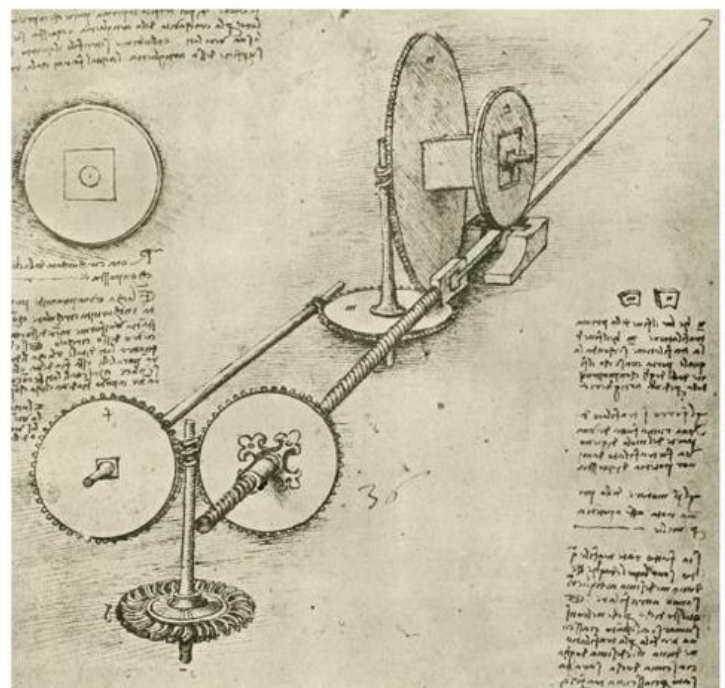
- Leonardo (b1452)
 - Systematic experimentation (not just speculation)
 - Not interested in tradition
 - Forces shape nature
 - Inductive method
 - The Earth rotates on its axis, the Sun does not move (pre-Copernican)
 - Manuscripts "lost" until the 18th century but widely circulated in his lifetime

What the Renaissance knew

- Leonardo (b1452)
 - Mechanical engineering



courtesy of www.leonardoda-vinci.org



What the Renaissance knew

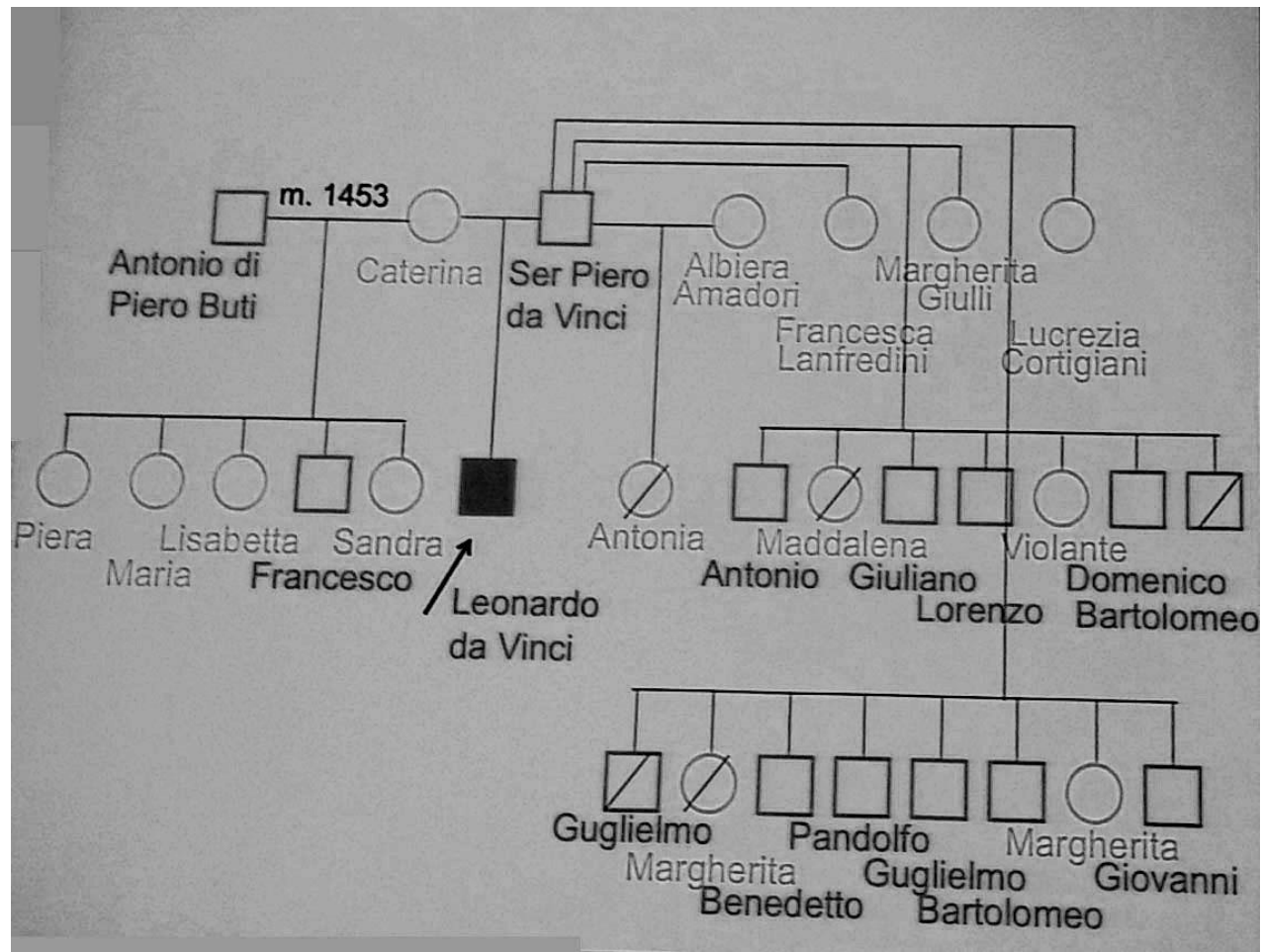
- Leonardo (b1452)
 - Mechanical engineering
 - Before Leonardo: military and architecture
 - After Leonardo: industrial applications and link with science
 - Larger towns require more powerful waterworks
 - (eg Juanello Turiano's waterworks of Toledo, 1526)

What the Renaissance knew

- Leonardo (b1452)
 - Mechanical engineering
 - Leonardo's influence:
 - Gerolamo Cardano's "Opus novum de proportionibus" (1570),
 - Giambattista della Porta's "Magia Naturalis" (1558),
 - Georg Bauer "Agricola"'s "De re Metallica" (1550), "founder of geology"
 - Agostino Ramelli's "'Li diverse et artificiose machine del Capitano A. R." (1588),
 - Vittorio Zonca's "Novo Teatro di Machine et Edificiï" (1603)

What the Renaissance knew

- Leonardo (b1452)
 - Leonardo's family



What the Renaissance knew

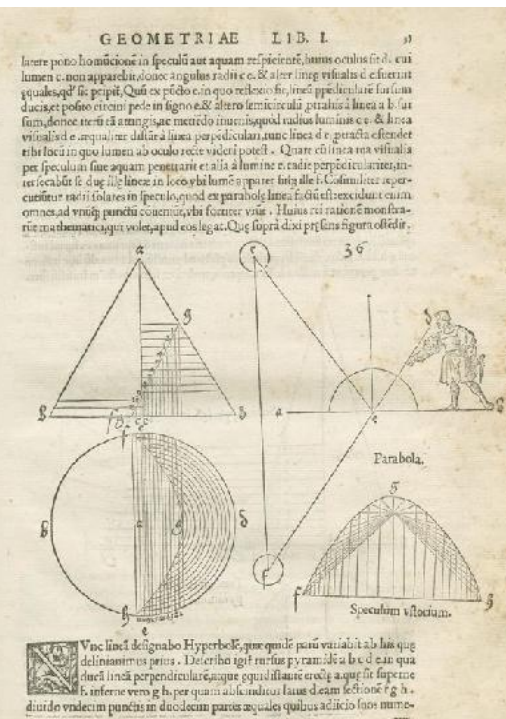
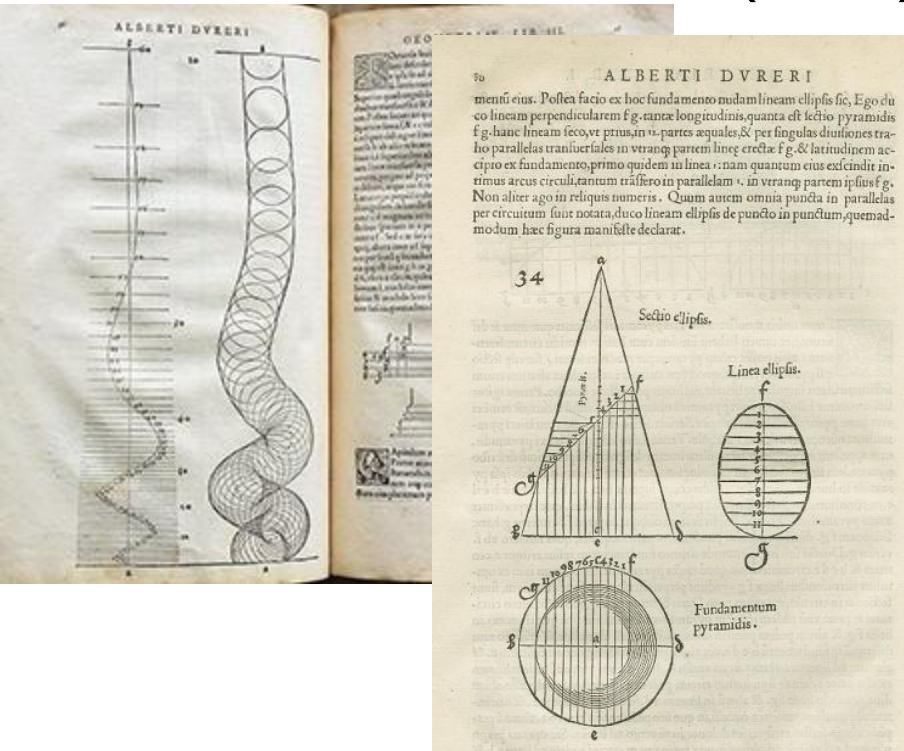
- Before Science
 - Thomas Aquina's synthesis: Aristorelian philosophy, Ptolemy's astronomy, Galen's medicine and the Biblical account of the creation
 - Knowledge only comes from revelation (the scriptures for Protestants, the Pope for Catholics)
 - The ancient knew more than the modern know

What the Renaissance knew

- Mathematical treatises
 - Piero della Francesca (Florence): "Libellus de de Quinque Corporibus Regularibus/ On the Five Regular Solids" (1480)
 - Luca Pacioli (Milan): "Divina Proportione" (1509), written in Italian, not in Latin
 - Celio Calcagnini: "Quod Caelum Stet, Terra Moveatur/ That the sky stands still and the earth moves" (1525): the Earth rotates and the heavens are at rest.
 - Note: no mathematics in Leonardo's notebooks

What the Renaissance knew

- Mathematical treatises
 - Albrecht Durer (Germany): "Four Books on Measurement" (1525), written in German, not in



Am, Bilibal de prestantissime amicissimèque, scribēdi finem faciam, atque deo optimo maximo fauēre ad eos libros quos de humana proportionē conscripsi, & alios quosdam ad idē spectantes edēdos suo tempore me accingam.

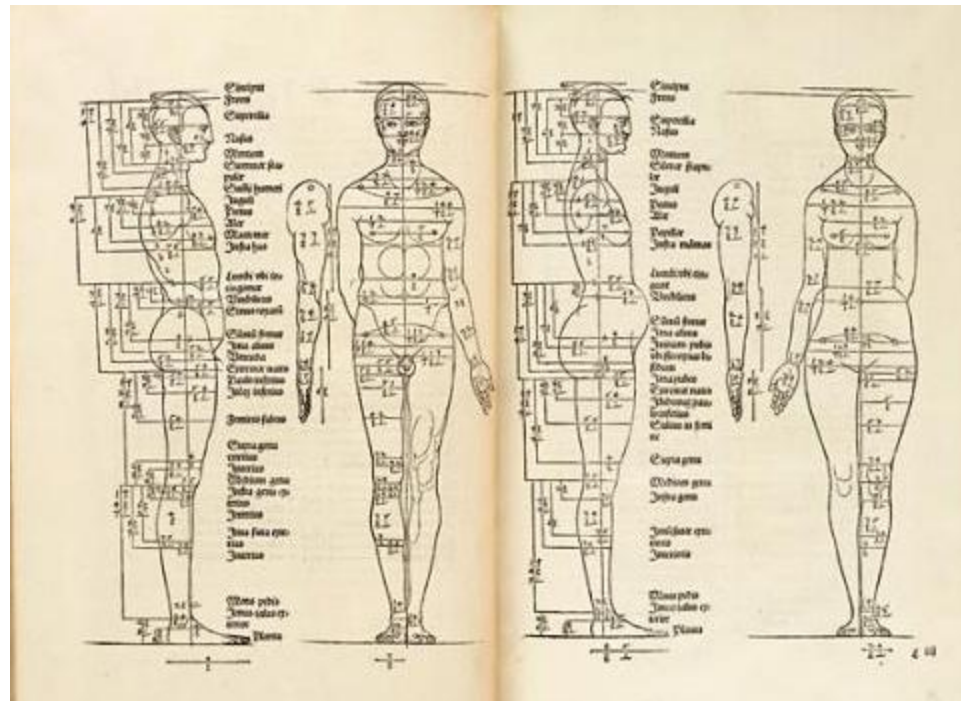
Deo omnipotenti sit laus gloria & imperium.

FINIS.

Lutetiae apud Christianum Wechelum,
Anno M.D.XXXII. Nonis Augusti.

What the Renaissance knew

- Mathematical treatises
 - Albrecht Durer: "Four Books on Human Proportions" (1528)



What the Renaissance knew

- Mathematical treatises
 - Gerolamo Cardano: “Ars Magna” (1545)
 - Niccolò Tartaglia: “General Trattato di Numeri et Misure” (1556), a 1,500-page book in Venetian dialect
 - Giambattista Benedetti: “Diversarum speculationum mathematicarum, & physicarum liber/ Book of Various Mathematical and Physical Ideas” (1585): the velocity of free-falling bodies does not depend on their weight (before Galileo)

What the Renaissance knew

- Mathematical treatises
 - Mathematical mechanics needed for
 - water-power in mining industry
 - cannons (e.g. the trajectory of a ball)
 - timepieces and planetaria

What the Renaissance knew

- Base 10 and decimals
 - Babylonians: base 60 (sexagesimals)
 - Francois Viète: "Canon-mathematicus" (France, 1579)
 - Base-ten decimals instead of base-60 sexagesimals
 - "Sexagesimals and sixties are to be used sparingly or never in mathematics, and thousandths and thousands, hundredths and hundreds, tenths and tens, and similar progressions, ascending and descending, are to be used frequently or exclusively."
 - Simon Stevin: "De Thiende/ Te Tenth" (Netherlands, 1585) promotes the "decimal" system
 - John Napier (Scotland, 1617): modern decimals (eg, 3.24)

What the Renaissance knew

- Science
 - Difference between philosophy and science: the method
 - Scientific knowledge spreads and thrives despite pervasive and perennial chaos and violence
 - Scholars create a supra-national nation of letters
 - Knowledge can be learned by studying the world
 - Bacon: scientists must work together in societies

What the Renaissance knew

- Science
 - Main center of scientific research: Italy
 - Leonardo, Copernicus, Galileo
 - Accademia dei Lincei, Roma (1603)
 - French Academy (1634), then French Academy of Science (1666)
 - Academia Leopoldina, Germany (1652)
 - Accademia del Cimento, Firenze (1657)
 - Royal Society of Science, London (1660): create knowledge instead of just transmitting knowledge (as medieval universities did)

What the Renaissance knew

- Science
 - First scientific journal, “Philosophical Transactions” (1665)
 - Printed press encourages books in national languages and Latin is no longer the universal language of science
 - Mathematics becomes the universal language of science
 - Edmund Halley predicts that the comet of 1682 will reappear in 1759

What the Renaissance knew

- Science
 - Atomic theory begins to erode Aristotelian dogma
 - David van Goorle: "Exercitationes philosophicae" (1612)
 - Daniel Sennert: "De chymicorum cum Aristotelicis et Galenicis consensu ac dissensu" (1619)
 - Sebastien Basson: "Philosophiae naturalis adversus Aristotelem libri XII/ Twelve books of natural philosophy against Aristoteles" (1621)

What the Renaissance knew

- Science
 - Astral bodies do not use circular motion (Kepler)
 - Very fast: Olaus Roemer determines the speed of light (1676) - the speed of light is finite
 - Very small: Anton van Leeuwenhock proves the existence of microorganisms (1674)
 - Very far and very big: Galileo (1610) documents the mountains of the Moon and the moons of other planets (Jupiter)
 - Medicine is to heal a body that has been attacked from the outside (Paracelsus)

What the Renaissance knew

- Science
 - Most scientific discoveries take place outside the universities
 - Academies and societies are private or royal

What the Renaissance knew

- Science
 - Arabs and China have as many scientists as the West
 - Chinese scientists work for the emperor mainly as astronomers and are not motivated to argue among themselves or against their predecessors
 - Arab scientists work for mosques and are not motivated to argue among themselves or against the Quran
 - Western scientists are mostly independent, they argue among themselves and argue against traditional beliefs

What the Renaissance knew

- School of Padova/Padua
 - Philosophy influenced by medical school
 - Hypothetical-deductive method
 - Giacomo Zabarella: "Opera Logica" (1578)
 - Bernardino Telesio: "De Rerum Natura iuxta Propria Principia" (1586) - criticism of Aristotelian natural philosophy and Galenic physiology

What the Renaissance knew

- The century of women
 - Caterina Cornaro, queen of Cyprus (1468)
 - Lucrezia Borgia, duchess of Este (1501)
 - Margaret of Austria, regent of the Netherlands (1507)
 - Louise of Savoy, regent of France (1515)
 - Margaret, queen of Navarre (1527)
 - Caterina de Medici, queen of France (1547)
 - Elizabeth I, queen of England and Ireland (1558)
 - Christina Wasa, queen of Sweden (1640)
 - Anna Maria van Schurman, linguist: "Dissertatio de ingenii mulieribus ad doctrinam et meliores litteras aptitudine" (1639)

What the Renaissance knew

- America (1492)

Jan Mostaert: The West Indies (1475)
(but he had never been there)

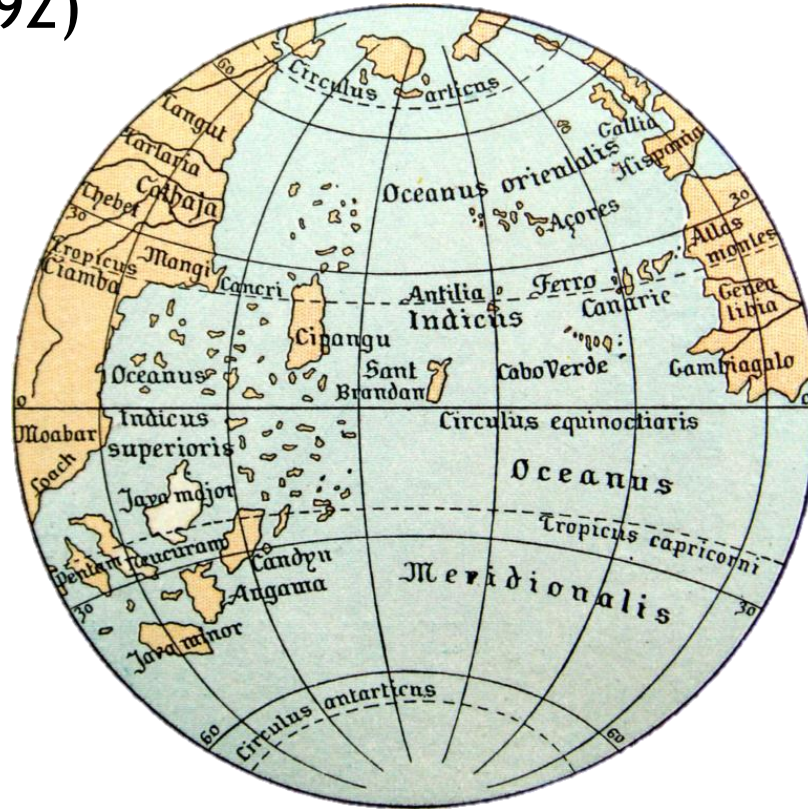


What the Renaissance knew

- America (1492)
 - Psychological impact
 - First-hand experience is more valuable than traditional beliefs
 - Modern people discovered a continent that the ancient Greeks and Romans never discovered
 - America is not in the Bible
 - There is knowledge that is not in the ancient classics nor in the scriptures
 - The inferiority complex towards the “classics” may not be justified
 - The unknown is exhilarating
 - It creates the mindset for the scientific revolution

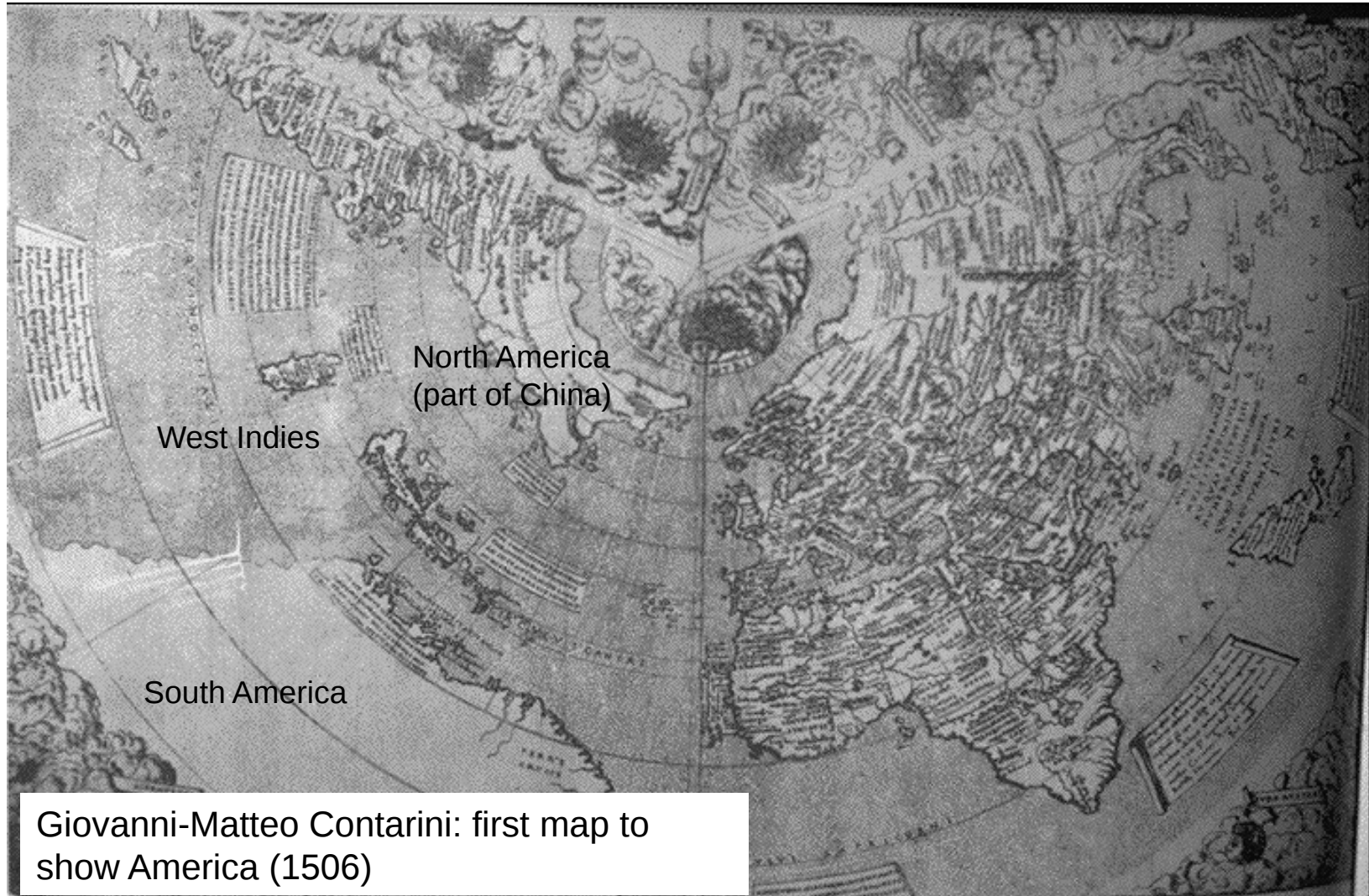
What the Renaissance knew

- America (1492)



What the Renaissance knew

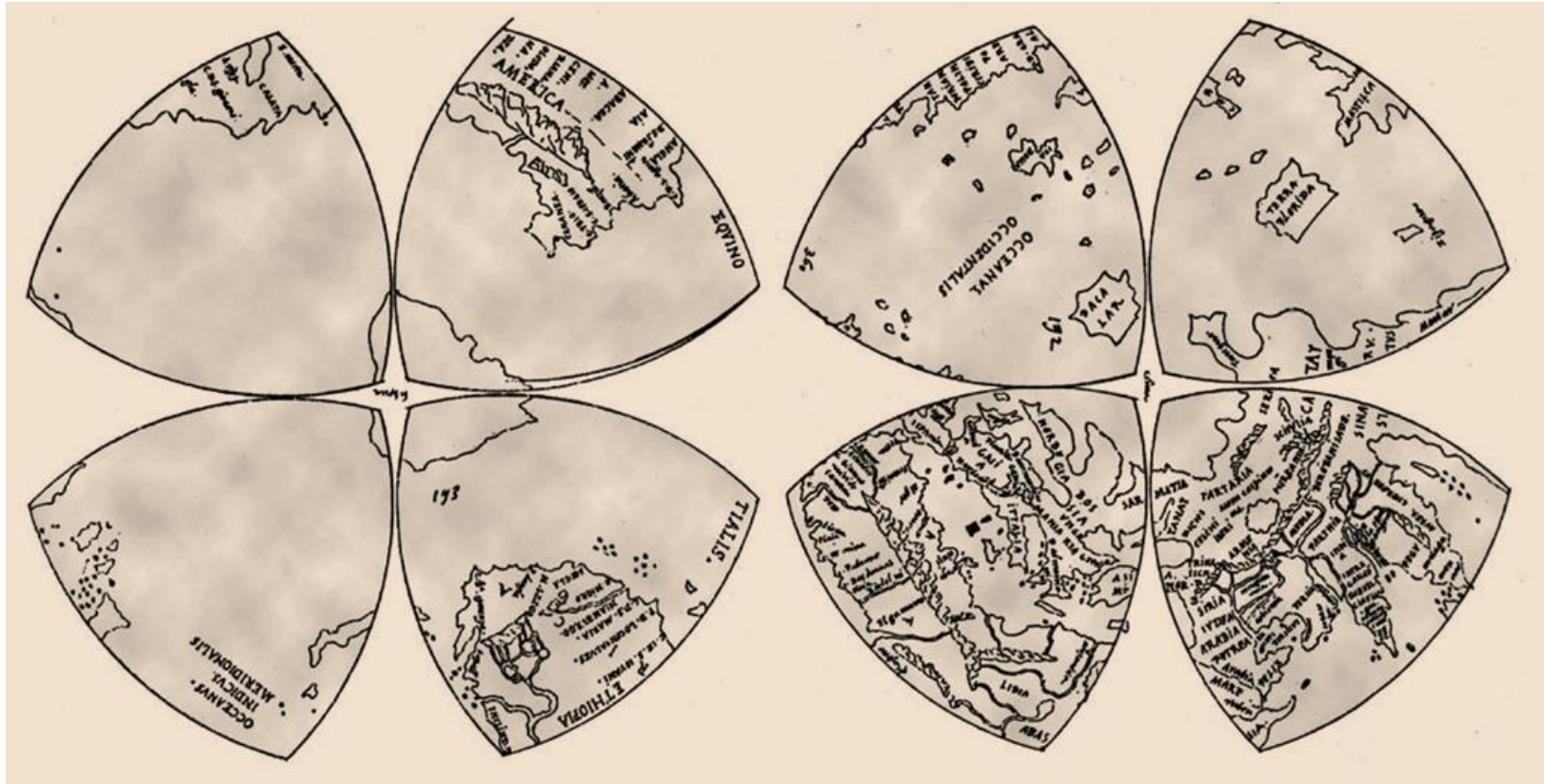
- America (1492)



Giovanni-Matteo Contarini: first map to show America (1506)

What the Renaissance knew

- America (1492)



Leonardo's map (1506)

What the Renaissance knew

- America (1492)



Hunt-Lenox Globe (~1506, NY Public Library)

What the Renaissance knew

- America (1492)



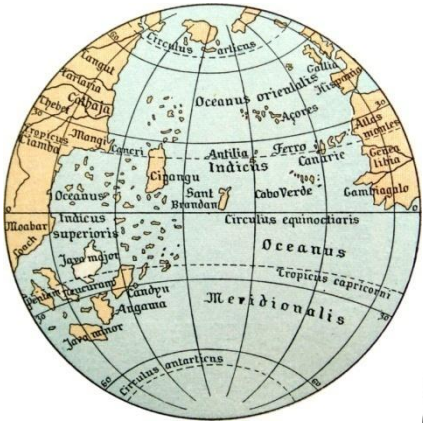
Detail of the Vespucci inset (1507)

What the Renaissance knew

- The oldest surviving globe of the Earth, the Erdapfel, was made in 1492, just before Columbus's return (Martin Behaim, Nuremberg)
- it contains no sign of the Americas and yet demonstrates the common belief in a spherical Earth



What the Renaissance knew



A. Erdapfel ~ (1490)

(1492)

Temporal Progression → →



C. HuntLenox (~1506)



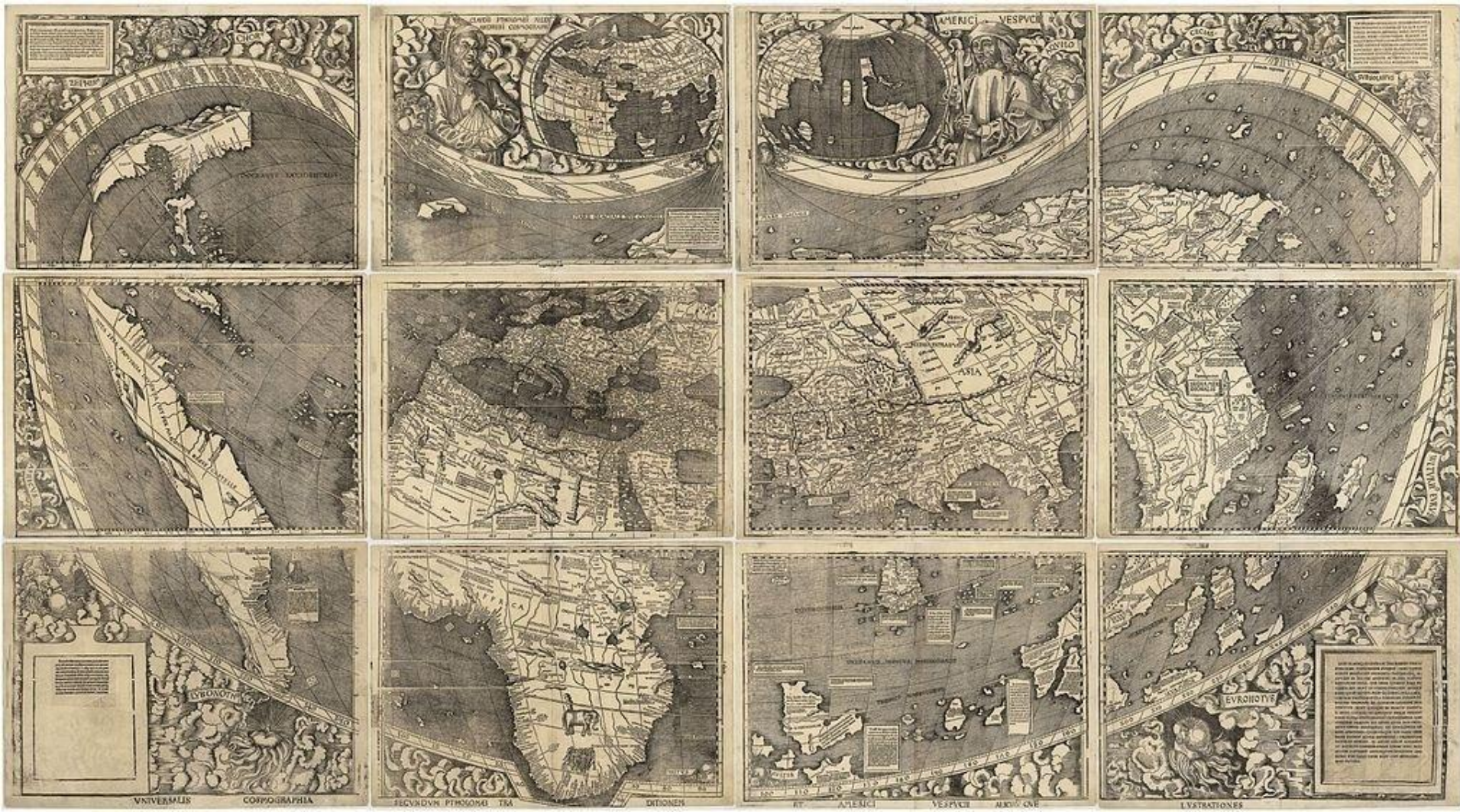
D. Waldseemüller (1507)

Temporal progression



America

Martin Waldseemüller's map
1507, first map to show Columbus'
land as a separate continent and to
call it America





Martin Waldseemüller's map
1507

What the Renaissance knew

- Krishna Chaitanya Mahaprabhu (b 1486): Renaissance of Vaishnavism in West Bengal
 - Madhva's tradition
 - But devotion for Radha and Krishna, the divine couple of Vrindavan
- Vallabha (b 1479) in Northern India: Vallabhaism
- Hit Harivamsha (b 1502)
- Swami Haridas (b 1480)
- Mirabai (b 1498): female saint and poet

What the Renaissance knew

- Aldo Manuzio/ Aldus Manutius (1503)
 - Invented
 - libri portatiles of his 1503), i.e. the paperback: inexpensive transportable books in small formats bound in vellum (the first book that truly spread)
 - the italic type
 - the comma
 - Publishes classics of Greek philosophy
 - Academy of Hellenists (1502)



(11x16cm)

VS



(30x44cm)

What the Renaissance knew

- Reformation (1517)
 - Desiderius Erasmus (Rotterdam, 1509)
 - Restoring a direct connection between the individual and the original meaning of ancient Christianity

What the Renaissance knew

- Reformation (1517)
 - The Church owns one third of German land
 - Corruption of the Church (eg, sale of indulgences)
 - Political rivalry between Pope and rulers

What the Renaissance knew

- Reformation (1517)
 - Martin Luther (Wittenberg, 1517)
 - Sola fede: salvation from faith alone (sin is inescapable and cannot be redeemed by penance or indulgence)
 - Sola scriptum: Faith comes from knowledge of God's scriptures (the Bible is the sole authority on God)
 - All faithfuls are equal
 - Reaction against the rationalism of the Scholastics

What the Renaissance knew

- Reformation (1517)
 - Martin Luther (Wittenberg, 1517)
 - Printed by a printing press
 - Written in vernacular German
 - 30 pamphlets in 4 years that sold more than 300,000 copies
 - The first good translation of the Bible in a vernacular language

What the Renaissance knew

- Reformation (1517)
 - Martin Luther (Wittenberg, 1517)
 - Von Den Juden und Ihren Luegen/ On the Jews and their Lies
 - Anti-semitic propaganda (the blueprint for Hitler's "Mein Kampf")
 - "Their synagogues should be burned"
 - "Their homes smashed"
 - "Put under one roof or in a stable"
 - "Should be drafted into forced labor"

What the Renaissance knew

- Reformation (1517)
 - Martin Luther
 - “Revocation of Purgatory” (1530)
 - Luther sees it as purely a pretext for indulgences (that are supposed to help the deceased through purgatory into heaven)
 - But protestants now have a problem: what happens to the soul after death? does it ascend immediately to paradise? Shouldn't it wait until the Last Judgment? What happens to the soul between death and Last Judgment?
 - And indirectly it relieves the living from any duties towards the dead

What the Renaissance knew

- Reformation
 - 1518: Huldreich Zwingli preaches against the Catholic Church in Switzerland
 - 1531: Civil war in Switzerland between Catholics and Protestants

What the Renaissance knew

- Reformation
 - Johannes Calvinus (Geneve, 1536)
 - Faith/salvation is granted only to some (predestination)
 - Only two sacraments: baptism and eucharist
 - No purgatory (*“Moreover, to pry curiously into their intermediate state is neither lawful nor expedient”*)

What the Renaissance knew

- Reformation
 - Johannes Calvinus (Geneve, 1536)
 - Schools and a university that attracts students from all over Europe
 - Printing presses in Geneve started by Lyon emigrants
 - Geneve becomes a center of Protestant propaganda
 - Geneve becomes a totalitarian theocracy

What the Renaissance knew

- Reformation
 - Johannes Calvinus (Geneve, 1536)
 - Calvinism spreads to France (the “Huguenots”) and Britain (“Presbyterians”)
 - Appealing to the business class (no punishment for usury)
 - Appealing to the Netherlands that are oppressed by Catholic Spain

What the Renaissance knew

- Reformation
 - John Knox (Britain, 1546)
 - 1560: Presbyterian Church modeled after Calvinism
 - 1560: Foments a civil war that overthrows that Catholic queen-regent
 - “An elementary school in every parish, a grammar school for every market town, and a university for every city”

What the Renaissance knew

- Reformation
 - The Bible rather than the Church as the source of religious authority
 - End of the ecclesiastical supremacy of the Pope
 - Emphasis on personal judgment
 - Protestant churches
 - German nationalist sentiment

What the Renaissance knew

- Reformation
 - Britain: Henry VIII's love for Anne Boleyn, not ideology, causes the rift with the Pope
 - 1534: Henry VIII declares himself supreme head of the Church of England and starts the "Anglican" Church
 - Thousands of Catholics executed for refusing to accept the royal supremacy
 - Monastery expropriated and distributed to the aristocracy
 - 1552: the "Book of Common Prayers" (without the eucharist)

What the Renaissance knew

- Reformation
 - 1537: Denmark and Norway
 - 1544: Sweden and Finland
 - Netherlands become Calvinist while fighting Catholic Spain

What the Renaissance knew

- Reformation
 - Consequences:
 - Regional political and cultural independence
 - Nationalist movements
 - Democratic aspirations
 - Decline of medieval system of authority
 - Free trade and banking (capitalism)
 - National languages and literature (instead of Latin)

What the Renaissance knew

- Reformation
 - Consequences:
 - Confiscation of monastic properties in Britain, Sweden and Holland
 - The Protestants don't recognize the Pope and have no Pope (unlike the Orthodox who have their own Pope)

What the Renaissance knew

- Counter-Reformation
 - 1513-34 The two Medici popes
 - 1517: Luther's Reformation
 - 1523-1578: all popes are Italian
 - 1527 The Sack of Rome by mutinous troops of emperor Karl V
 - 1534: Paul III of the Farnese family, who has an illegitimate son
 - 1540: The Jesuits
 - 1545: Council of Trento

What the Renaissance knew

- Counter-Reformation
 - 1550: Julius III, who has a gay relationship with a teenage boy, patron of art and entertainment at his Villa Giulia, but not involved in the Church
 - 1559: Paul IV, a former Grand Inquisitor and practitioner of torture, issues a list of forbidden books, the "Index Expurgatorius"
 - The Church is still run by the Italian aristocracy
 - The Pope is frequently not a role model at all

What the Renaissance knew

- Counter-Reformation
 - Italy remains Catholic because
 - The Pope owns central Italy
 - Karl V (Napoli) and Felipe II (Sicilia) protect southern Italy from heresy
 - Two popes from the Medici family (Firenze)
 - Northern Italy borders on France and Austria that remain Catholic

What the Renaissance knew

- Counter-Reformation
 - Spain and Portugal remain Catholic because people fought Islam under the Catholic banner
 - Austria remains Catholic because people fought the Ottomans under the Catholic banner
 - France remains Catholic because the Pope allows the king to appoint bishops (Concordat of 1516)
 - Poland saved from Protestantism by the Jesuits
 - Ireland remains Catholic

What the Renaissance knew

- Counter-Reformation
 - Last-ditch attempt to control the minds of Christian Europe
 - 1559: “Index Expurgatorius” bans three quarters of the books printed in Europe (including Copernicus and Galileo)
 - Loss of power and prestige by the Church despite its wealth
 - 1648: The powers sign the "Peace of Westphalia“ largely ignoring the Pope



Antonio Lafreri: "Seven Churches of pilgrimage of Rome" (1575)
 (Metropolitan Museum of Art, New York)

What the Renaissance knew

- Counter-Reformation
 - Jesuits (1534)
 - Ignatius of Loyola founds the Society of Jesus (Jesuits), which believes in free will and in salvation through good deeds
 - Soldiers of God
 - Counter Reformation
 - Established schools and colleges throughout Europe (500 colleges in 1640)
 - The leaders in European education till the 18th c

What the Renaissance knew

- Counter-Reformation
 - Jesuits (1534)
 - Missions to India, China and Japan
 - Communes in South America
 - Opposition to totalitarian rulers and passion for ecclesiastical reform (antagonizing both kings and popes)
 - Defended by enlightened rulers such as Frederick II of Prussia and Catherine II of Russia
 - The Bourbon kings of France and the Pope dissolve the order in 1773

What the Renaissance knew

- Counter-Reformation
 - Mystics
 - Ursulines (Italy, 1535)
 - Teresa of Avila's cloister (Spain, 1562)
 - San Juan de la Cruz (Spain)
 - Jansenism (France)
 - Trappism (France, 1660s)
 - Francois de Sale (Switzerland)
 - Visitandines (Switzerland, 1610)
 - Les Filles de la Charité (France, 1633 - Vincent de Paul)

What the Renaissance knew

- Reformation and Counter-Reformation
 - Religious intolerance is directed more against Christians than against Jews, Muslims or pagans
 - Heresy is the worst disease
 - Each country has a list of banned books
 - Executions, massacres and civil wars within the Christian world
 - 1572: The massacre of Huguenots on St Bartholomew's Day
 - 1618–48: Thirty Years' War

What the Renaissance knew

- Reformation and Counter-Reformation
 - Witch hunting continues unabated in both Catholic and Protestant countries
 - Both Luther and Calvin believe in witches
 - Puritanical Protestants become more zealous than Catholics in persecuting witchcraft

What the Renaissance knew

- Reformation and Counter-Reformation
 - Decline in education in Protestant Europe because Church assets are seized including schools and universities
 - Puritans are hostile to universities, seats of scholastic teaching
 - Decline of art patronage because the Popes had been the main patrons of architecture, sculpture, painting and music
 - The arts in Protestant countries become more secular than religious

What the Renaissance knew

- The Orthodox church
 - Greece and Balkans (but the patriarch is in Istanbul, ruled by the Ottomans)
 - Russia (independent patriarchate in 1582)



What the Renaissance knew

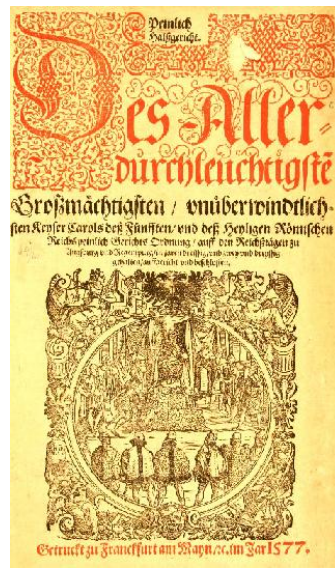


- Thomas More (1518)
 - A satirical account of life in Utopia
 - The interests of the individual are subordinate to those of society
 - All people must do some work
 - All land is owned in common

What the Renaissance knew

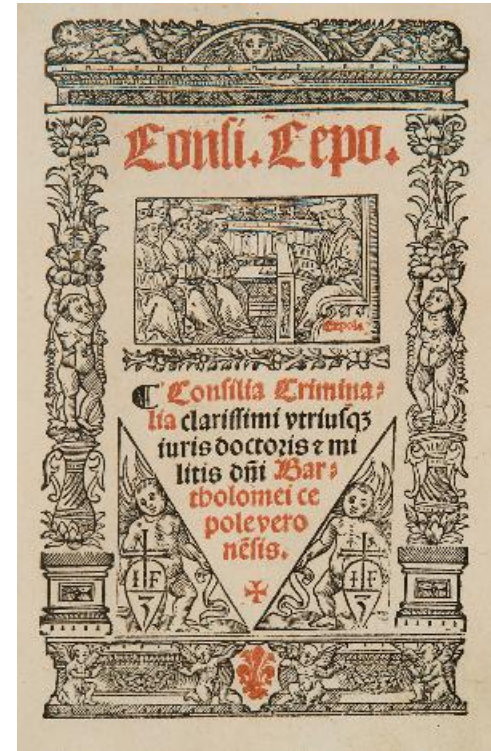
- The Law
 - Criminal codes
 - Germany (Holy Roman Empire):
"Constitutio Criminalis Carolina" (1532)
 - Spain: "Nueva Recopilacion" (1537)
 - France: "Ordonnance Royale" (1539)
 - They all enforce torture to extract confessions

Carolina:



What the Renaissance knew

- The Law
 - Manuals of Law
 - Ippolito Marsili: "Practica Causarum Criminalium Una Cum Theorica Et Repertorio Domini" (1529)
 - Prospero Farinaccio: "Praxis Et Theoricae Criminalis" (1588)
 - Benedikt Carpzov: "Practica nova Rerum Criminalium" (1636)



What the Renaissance knew

- The Law
 - Critics of witchcraft persecution and torture (16th-17th c)
 - Cornelius Loos: “De vera et falsa magia” (unpublished)
 - Adam Tanner: “Theologia Scholastica” (1629)
 - Friedrich Spee: “Cautio Criminalis” (1631)
 - Johann Gräfe: “Tribunal Reformation” (1624)
 - Benedikt Carpzov: “Practicae novae Imperialis Saxonicae rerum criminalium” (1635)



What the Renaissance knew

- The standard model of science
 - The Earth is at the center of the universe
 - The heavens are organized around the Earth in concentric revolving spheres
 - Each outer sphere is made of finer stuff
 - The planets are located in the first sphere
 - The stars are in the second sphere
 - The other spheres are for angels
 - The last sphere is God

What the Renaissance knew

- The standard model of science/ Problems:
 - Motion of Mars
 - Why does the arrow keep flying?
 - Why does the arrow stops flying?

What the Renaissance knew



- Mikolaj Kopernik/ Nicolaus Copernicus (1530, Poland)
 - Heliocentric theory
 - The sun is at rest at the center of the universe (Aristarchos' heliocentric theory)
 - The earth, spinning on its axis once daily, revolves around the sun in one year
 - The planets also circle the sun
 - The Earth is one of the planets
 - The fixed stars are on a finite, stationary sphere
 - The greater the radius of a planet's orbit, the greater the time the planet takes to revolve around the sun
 - The stars are very far
 - The universe is a sphere of a finite size (the ancient Greek view)

What the Renaissance knew

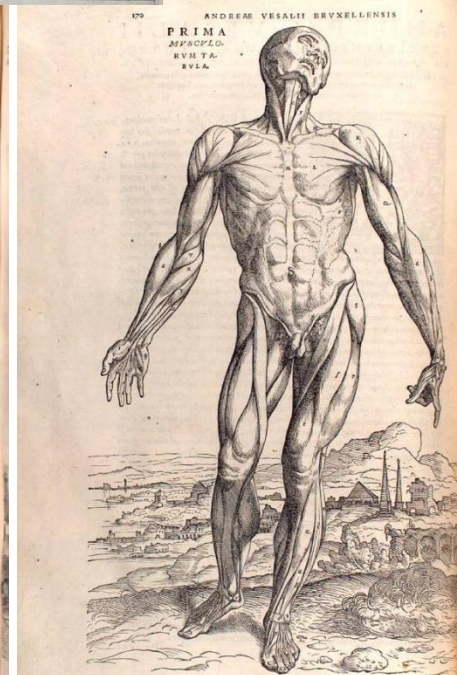
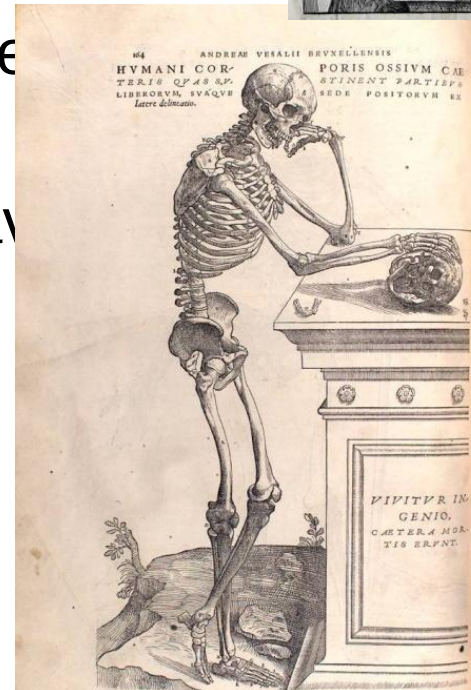
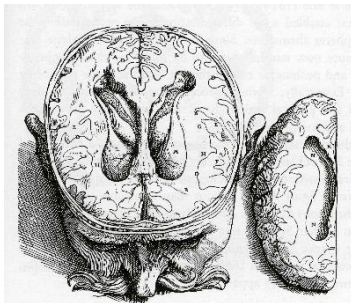
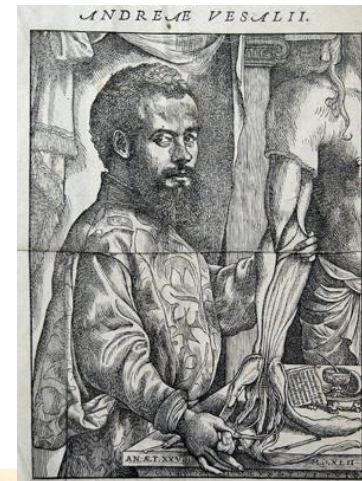
- Mikolaj Kopernik/ Nicolaus Copernicus
 - Heliocentric theory
 - A side effect of the discovery of America: if Ptolemy was wrong about the continents, and the Bible was missing America, then they might as well be wrong about the Earth's movement
 - Very little help from technology: Copernicus uses the same instruments used by Ptolemy

What the Renaissance knew

- Mikolaj Kopernik/ Nicolaus Copernicus
 - Heliocentric theory
 - Why don't we feel the 100,000 km/h speed of the Earth?
 - What force makes the Earth move?
 - No experimental evidence to support Copernicus' theory until Galileo discovers the moons of Jupiter
 - Trial of Galileo (1633)

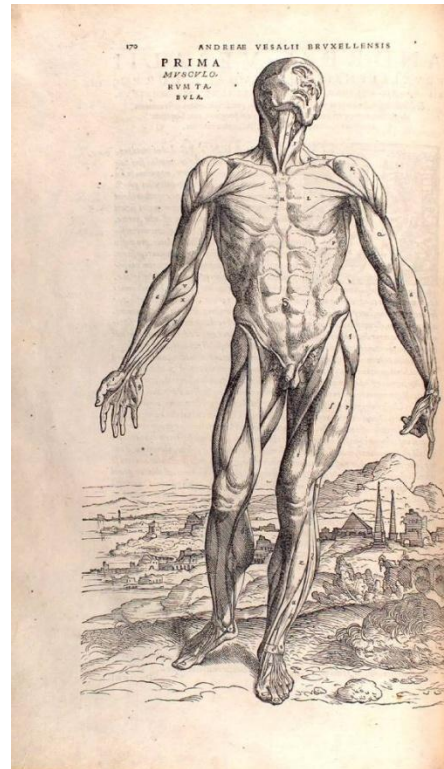
What the Renaissance knew

- Andreas Vesalius ‘ “De Humani Corporis Fabrica” (1543)
 - Dissection of human cadavers
 - Scientific foundation of anatomy
 - Refutation of traditional doctrines of Galen (first time 1300 years)
 - First major book with engraved illustrations



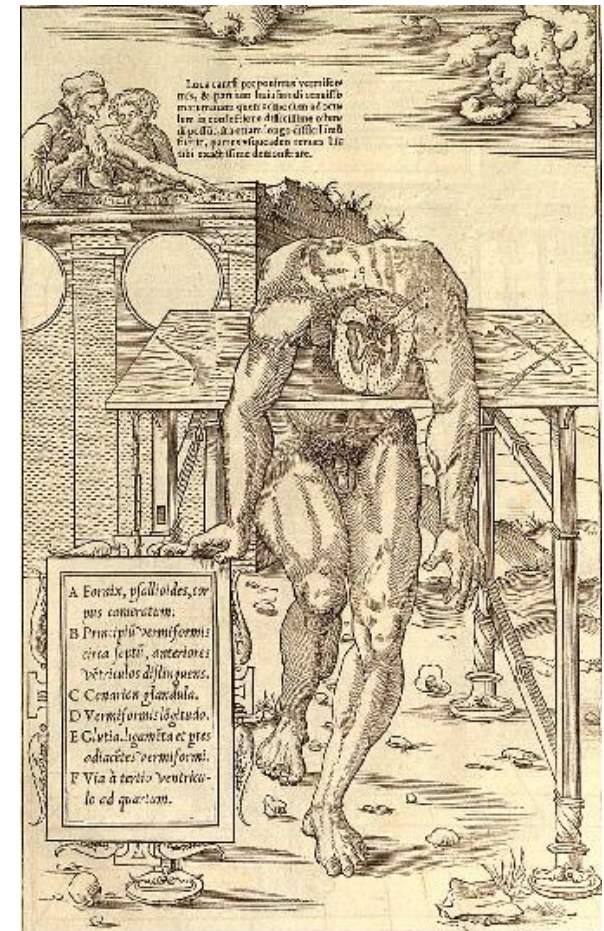
What the Renaissance knew

- Andreas Vesalius ‘ “De Humani Corporis Fabrica” (1543)



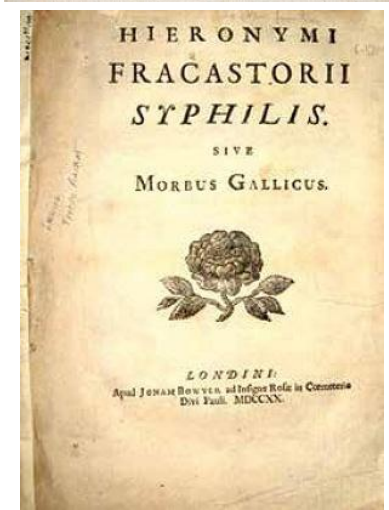
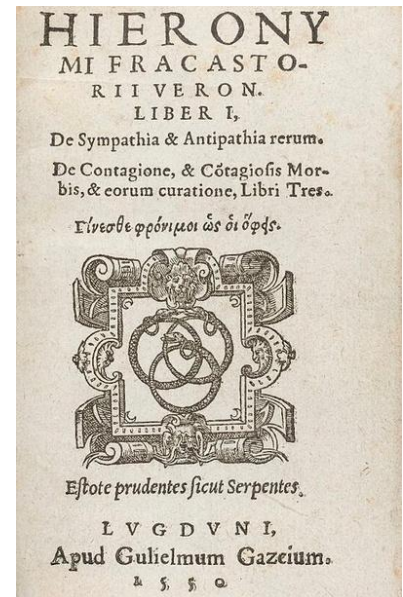
What the Renaissance knew

- Charles Estienne's "La dissection des parties du corps humain" (1546)



What the Renaissance knew

- Girolamo Fracastoro (1546)
 - "De Contagione et Contagiosis Morbis" (1546): proto-epidemiology, innovative theory of contagion (diseases are caused by "seminaria morbi" that are transmitted via contact with infected objects and via dispersion in the air)
 - Trivia: active in logic, anatomy, poetry, music, geography, geology, philosophy, astronomy (he proposed an alternative to the Ptolemaic astronomical system)
 - Trivia: he also wrote the 1300-verse poem "Syphilis Sive de Morbo Gallico" (1521) that gave syphilis its name



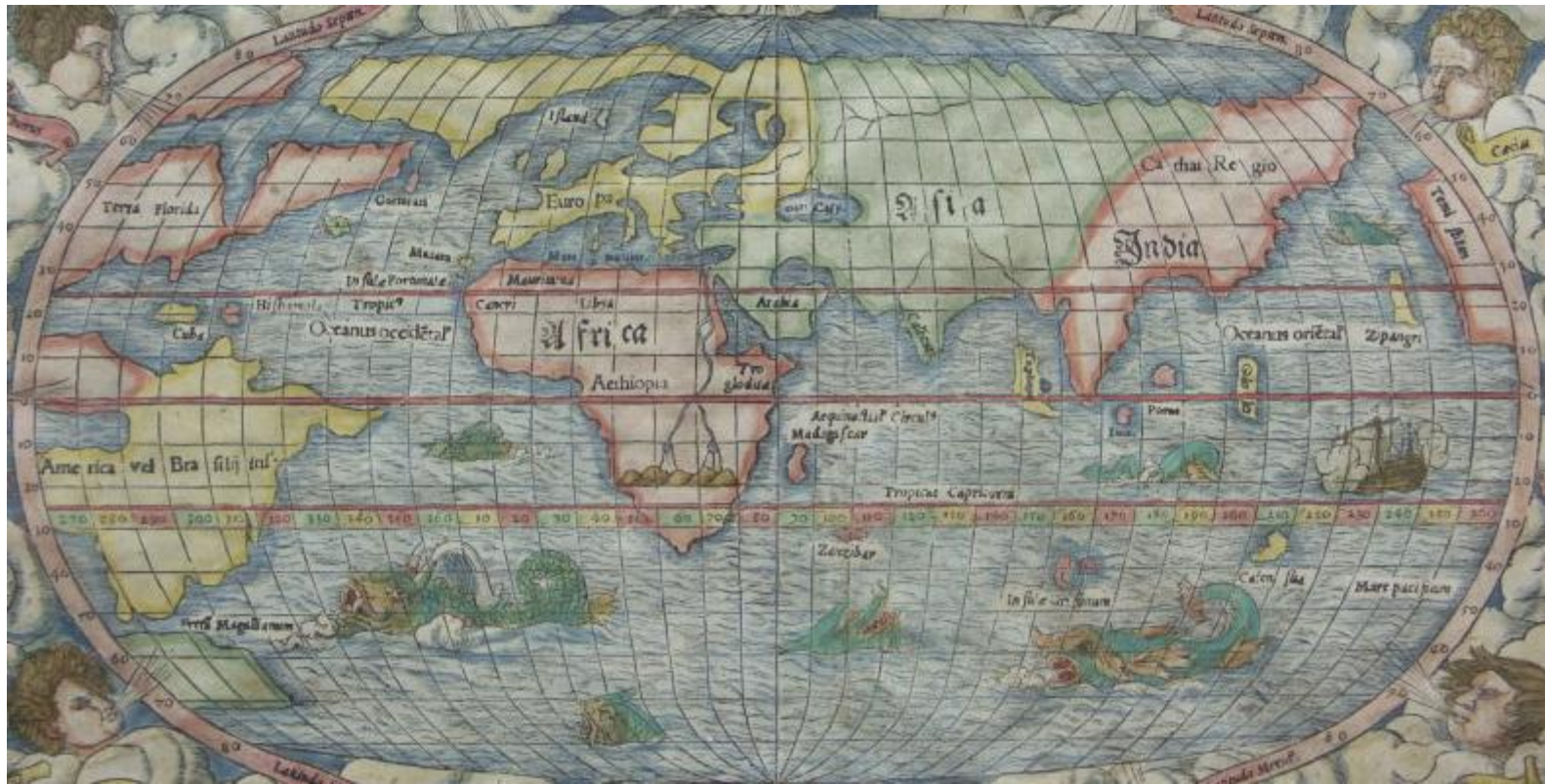
What the Renaissance knew

- Juan de Valverde's "Anatomia del Corpo Umano" (1560)



What the Renaissance knew

- Sebastian Münster' "Cosmographia" (1544)
 - Earliest German description of the world
 - Much more successful than Copernicus' book
 - Spawned revival of geography



What the Renaissance knew

- John Calvin (1559)
 - Protestant doctrine
 - Human beings have no free will after the fall
 - Predestination: some people are elected by God to salvation, others to damnation
 - The Bible as the unique source of truth
 - Subjugation of state to church
 - Commerce, industry, and hard work are virtues
 - Wealth is by divine grace
 - Synod of Dort (1618-19) in Holland
 - Huguenot movement in France
 - Puritanism in England (“Westminster Confession” of 1646)
 - Ideological foundation of Presbyterianism

What the Renaissance knew

- Capitalist morality
 - Protestantism: Salvation is an individual process, not related to the Church
 - Protestant moral values better suited for the emerging merchant/capitalist class
 - Calvin emphasized the elect predestined for salvation
 - The Church cannot provide salvation, your work does
 - Weber's theory: Calvinism sanctifies work, individual responsibility, irrelevance of the clergy
 - Protestantism encourages thrift, work, honesty
 - Protestantism legitimizes capitalist morality
 - Capitalism created Protestantism, not viceversa
 - Religion was a force opposing capitalism in Catholic countries, it became a force supporting capitalism in northern countries
 - Henry VIII converts to Protestantism (1529)

What the Renaissance knew

- Capitalist morality
 - Protestantism also dispossesses the Church of land (the Church owned much of the land)
 - Land and natural resources become available to capitalists
 - Protestantism ends the custom that property must be donated to the Church instead of keeping it in the family

What the Renaissance knew

- Giorgio Vasari (1550)
 - Virtue = creativity

What the Renaissance knew

- Giambattista Della Porta
 - Founder of the Accademia dei Segreti (1558)
 - L'Arte del Ricordare (1566): art of memory
 - Magia naturalis (1558): demonology, magnetism and the camera obscura
 - De Furtivis Litterarum Notis Vulgo De Ziferis (1563): ciphers
 - Thaumatalogia: demonology and magic
 - 20-volume version of Magiae Naturalis (1589)
 - De Refractione (1593): optics
 - “Invented” the telescope before Galileo
 - Elementorum Curvilinearum (1601): math

What the Renaissance knew

- Giambattista Della Porta
 - Physiognomonics: study of the visible affinities between all physical things, aid to predicting the future, astrology
 - De Humana Physiognomonica (1583)
 - Coelestis Physiognomonica (1603)
 - De' Spiritali (1606): machines (including a steam engine)
 - De Distillatione (1609): chemistry
 - De Munitione (1608): fortifications and firearms
 - De ea Naturalis Physiognomoniae parte quae ad manuum lineas spectat (1610): palmistry

What the Renaissance knew

- Giambattista Della Porta
 - De' Spiritali (1606): machines (including a steam engine)

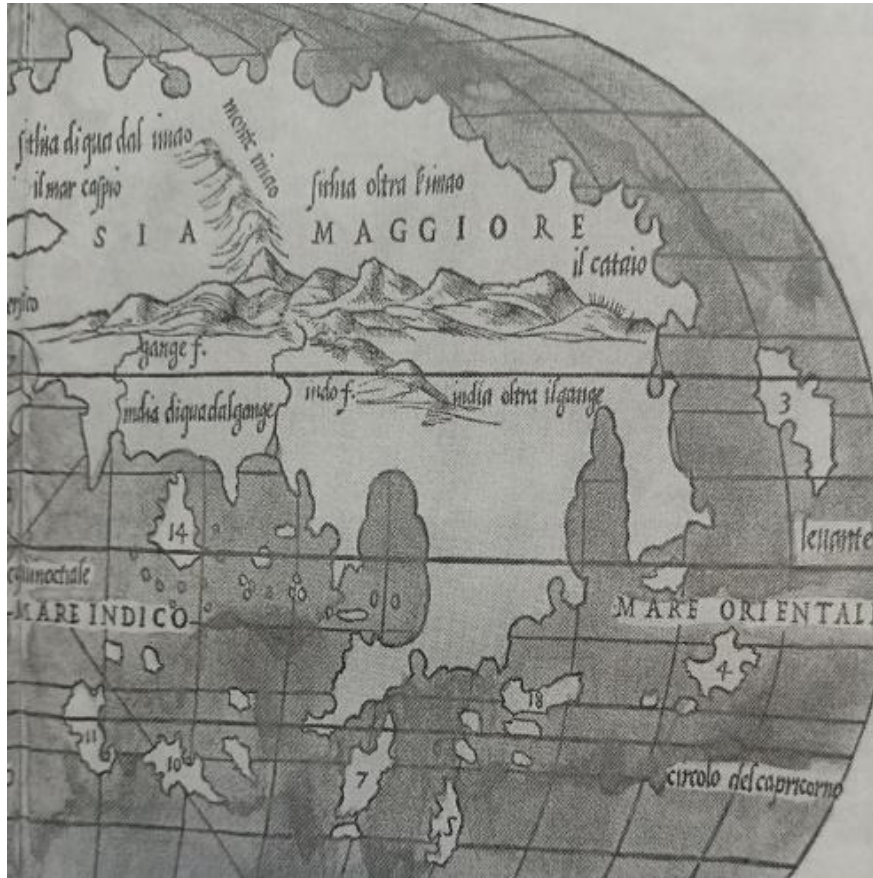


What the Renaissance knew

- Giambattista Della Porta
 - Villae (1592), which originally was Pomarium (1583) on growing fruit trees and Olivetum (1584): agriculture
 - Several comedies
 - Several of his books forbidden by the Church

What the Renaissance knew

- Cartography
 - Benedetto Bordone: “Isolario” (1528)



China, India And Far East



Venezia

What the Renaissance knew

- Cartography
 - Benedetto Bordone: “Isolario” (1528)



La gran città di Temistitan.



Europe

What the Renaissance knew

- Cartography
 - Matrakci Nasuh (1537)



Aleppo



Istanbul

What the Renaissance knew

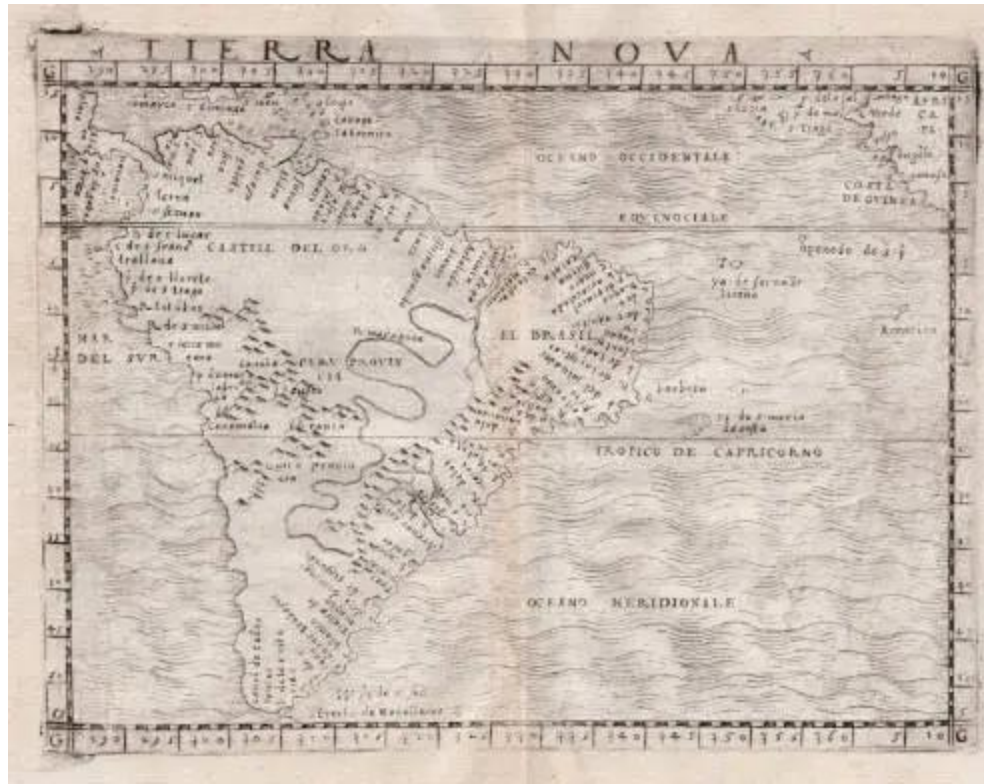
- Cartography
 - Jacopo Gastaldi: “La Geografia di Claudio Ptolomeo” (1548)



Europe

What the Renaissance knew

- Cartography
 - Jacopo Gastaldi: “Tierra Nova” (1548), first map of South America



What the Renaissance knew

- Cartography
 - Abraham Ortelius/Wortels (1570): "Theatrum Orbis Terrarum/ Theatre of the World": first atlas of the world
 - Gerhard Kremer "Mercator" (1567): Rumold's world map, drawn in 1587 after his father's map of 1567



What the Renaissance knew

- Cartography
 - See globes at museums/europe24/germanis.html

What the Renaissance knew

- Cartography
 - Urbano Monte's "Trattato Universale" (1587), a four-volume compendium of geography with the largest world map made in the 16th century

Urbano Monte's
planisphere (1587)



What the Renaissance knew

- Cartography
 - Georg Braun and Frans Hogenberg: “Civitates orbis terrarum” (1572)



Zurich



Cologne

What the Renaissance knew

- Cartography
 - Georg Braun and Frans Hogenberg: “Civitates orbis terrarum” (1572)



Toledo



Rome

What the Renaissance knew

- John Dee
 - “General and Rare Memorials pertayning to the Perfect Arte of Navigation” (1577), a manual for the creation of the British Empire

What the Renaissance knew

- Petrus Ramus/ Pierre de la Ramee (1569)
 - Critique of Aristotelian syllogism
 - Divorcing rhetoric from dialectic (logic)
 - "Dialecticae Partitiones" (1543) - criticism of Aristotle and Euclides, reform of education on more rigorous foundations

What the Renaissance knew

- Michel Montaigne (1580)
 - Essay, prose
 - Written in vernacular language (not Latin)
 - Revival of scepticism:
 - Negative philosophy
 - We know nothing
 - The senses are not reliable sources of knowledge
 - Reason is not infallible
 - God is unknowable
 - No ideal is worth dying for
 - Salvation is in doubt, not in faith



What the Renaissance knew

- Michel Montaigne (1580)
 - Before Montaigne: Philosophy prepares people to die well
 - After Montaigne: Philosophy prepares people to live well

What the Renaissance knew

- Joris Hoefnagel: "The Four Elements" (1582)
 - Water animals: fish and mollusks
 - Air animals: birds and amphibians
 - Earth animals: quadrupeds and reptiles
 - Fire animals: insects and humans

What the Renaissance knew

- Simon Stevin (1586)
 - Hydrostatics - e.g. law of the inclined plane
 - Proves experimentally that two objects of different weight fall down with exactly the same acceleration
 - Aristotle: heavy bodies fall faster than light ones
 - "The Tenth" (1585): manual of decimal fractions

What the Renaissance knew

- **Baroque Age (1600-1680)**
 - **Monarchical absolutism**
 - **Restoration of order after the creative disorder of the renaissance**

What the Renaissance knew

- Baroque Age (1600-1680)
 - National differences of ritual give rise to different religious and lay architecture
 - Opulence: age of sculpture and decoration
 - Decline of painting

What the Renaissance knew

- Astronomy
 - 1572: The supernova proves that Aristoteles was wrong, that the skies are not immutable
 - 1577: The comet terrifies Europe
 - 1582: Pope Gregory XIII reforms the calendar

What the Renaissance knew



- Tycho Brahe (1573, Sweden)
 - Discovered a nova (a new star)
 - Planets move freely in space (not on crystalline spheres)
 - But still the Aristotelian/Christian view:
 - Proof that the Earth cannot rotate
 - The Earth sits at the centre of the universe
 - Sun, Moon and stars revolve around the Earth
 - The planets revolve around the Sun
 - The world below the moon is imperfect and dynamic
 - The world above the moon is perfect and static

What the Renaissance knew

- Tycho Brahe (1573, Sweden)
 - Brahe's view:
 - The world below the moon is not as imperfect as we think
 - The world above the moon is not as perfect as we think



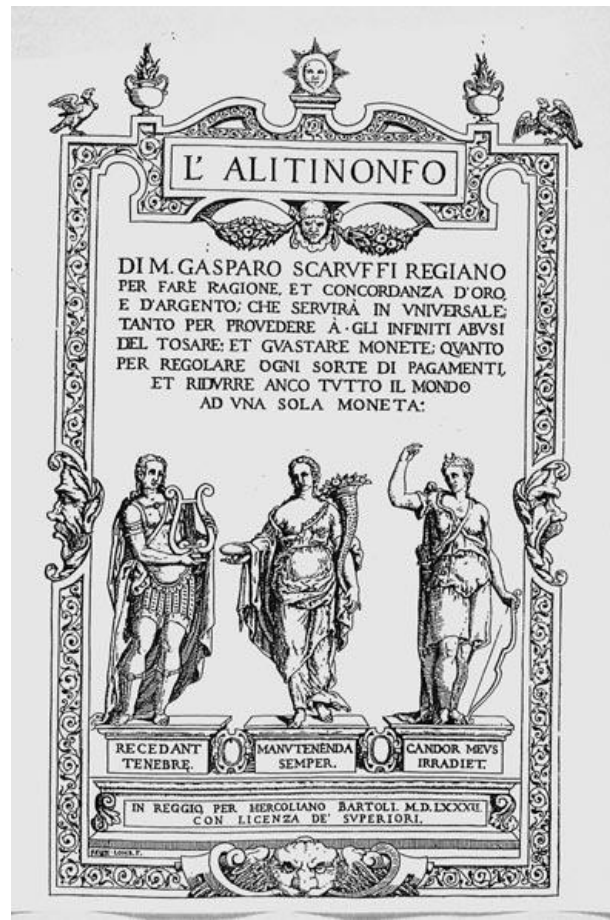
Brahe's observatory Uraniborg

What the Renaissance knew

- Giordano Bruno (1582)
 - All knowledge strives to know the One
 - Everything is God
 - All matter is one with God
 - Matter is made of atoms
 - Atoms are alive
 - The sun, not the Earth, is at the center
 - The universe was infinite and filled with infinite stars

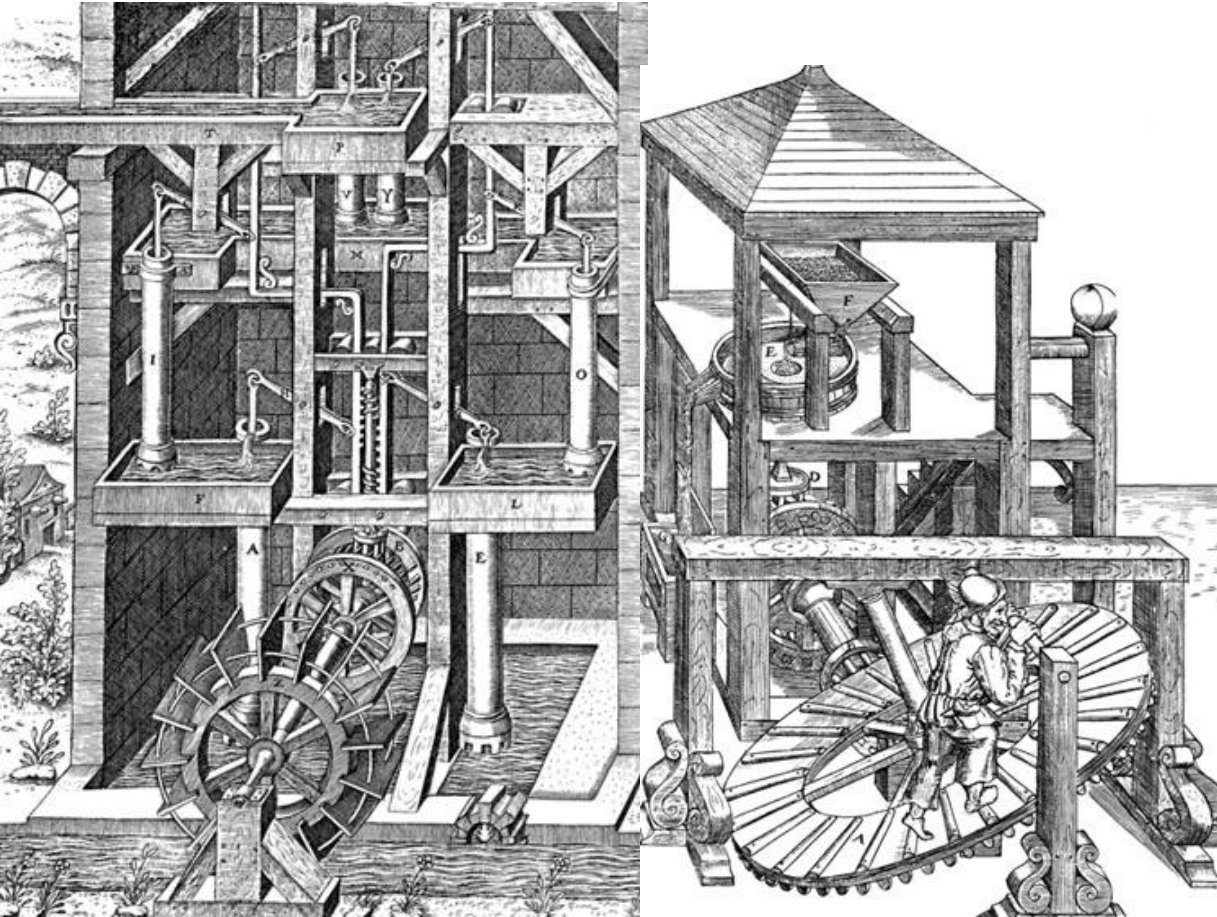
What the Renaissance knew

- Gasparo Scaruffi (1582)
 - One universal currency/ monetary utopia



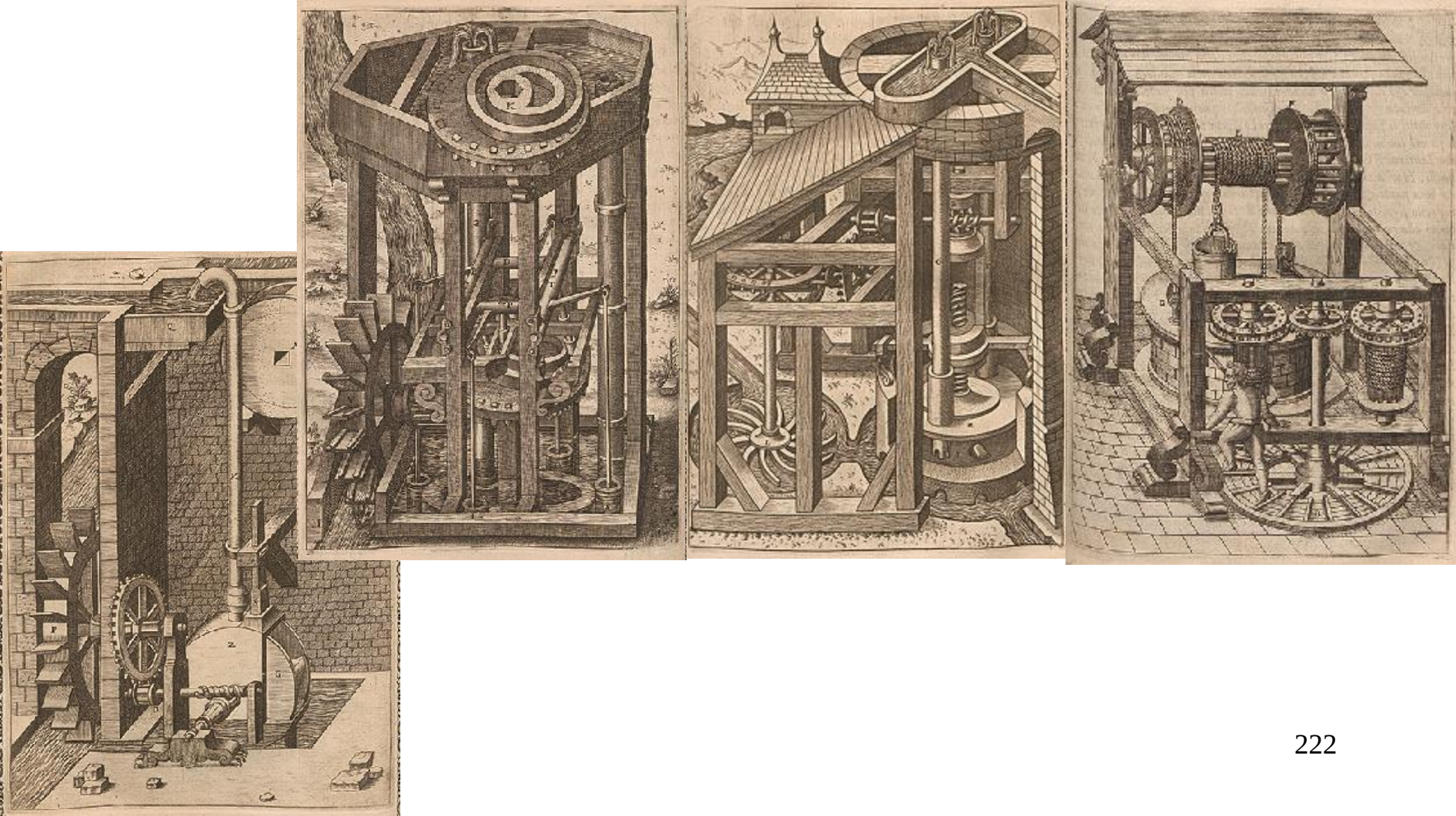
What the Renaissance knew

- Agostino Ramelli: "Li diverse et artifiose machine" (1588)



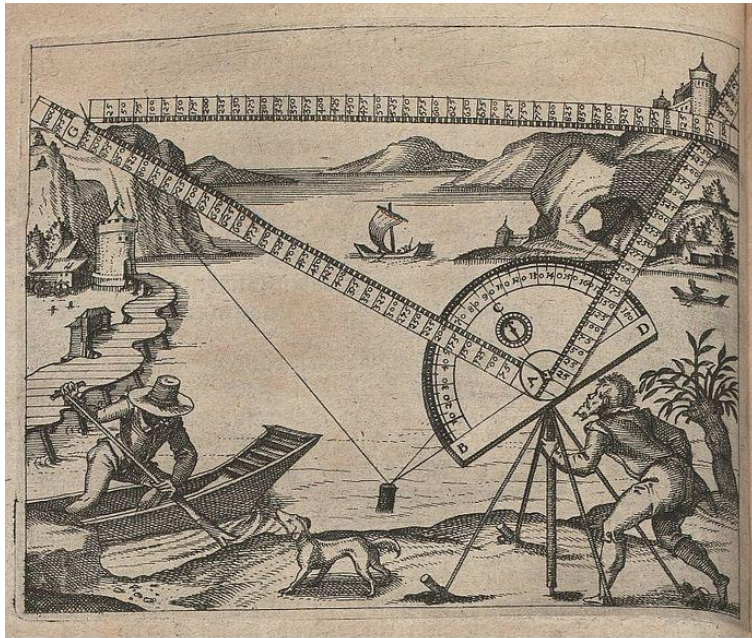
What the Renaissance knew

- Agostino Ramelli: "Li diverse et artifiose machine" (1588)

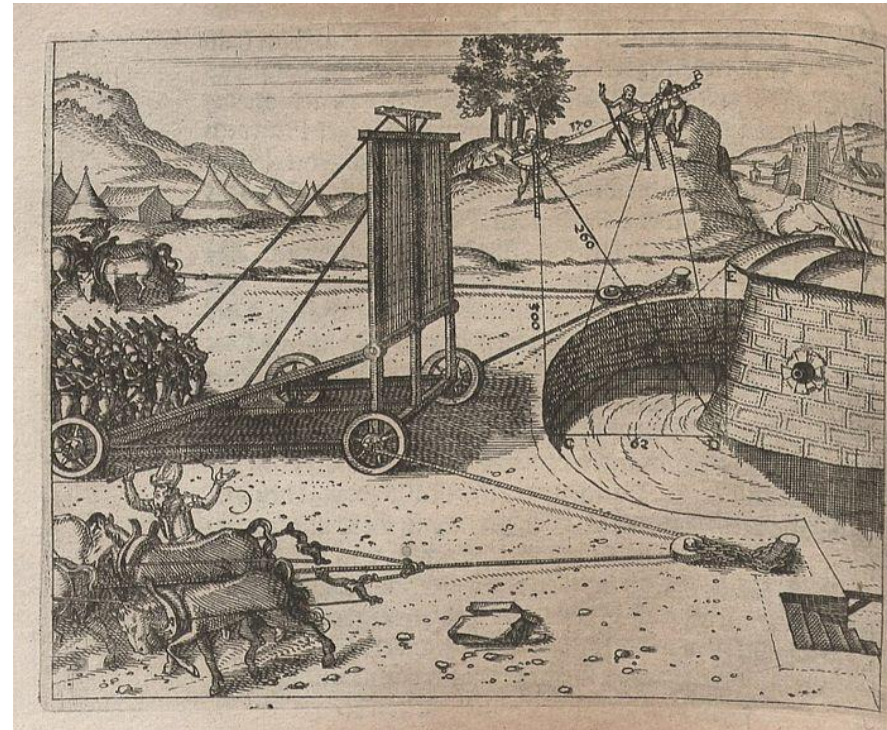


What the Renaissance knew

- Leonhard Zubler: “Novum Instrumentum Geometricum” (1607).



Quelle: Deutsche Fotothek



Quelle: Deutsche Fotothek

What the Renaissance knew

- **Francesco Carletti (1594)**
 - First tourist to travel around the world
 - Leaves for slave-trading expedition to Cape Verde
 - Boards Spanish ship to Panama
 - Colombia
 - Peru
 - Crosses Mexico to Acapulco
 - Ship to Philippines
 - Visits Japan
 - Boards Portuguese ship from Macao to Goa
 - Boards Portuguese ship from Goa to Lisbon
 - Robbed by pirates in St Helen
 - Returns home after eight years

RAGIONAMENTI
DI FRANCESCO
CARLETTI
FIORENTINO
SOPRA LE COSE DA LUI VEDUTE
NE' SUOI VIAGGI
Si dell' Indie Occidentali, e Orientali
Come d' altri Paefi.
ALL' ILLUSTRISS. SIG. MARCHESE
COSIMO DA CASTIGLIONE
GENTILUOMO DELLA CAMERA
DEL SERENISSIMO
GRANDUCA DI TOSCANA.



IN FIRENZE NEL GARBO,
Nella Stamperia di Giuseppe Manni 1701.
Per il Carlieri all' Insegna di S. Luigi.
Con Licenza de' Superiori.

Trivia

- What happened in
 - Italy, Spain and Poland between 4 Oct 1582 and 15 Oct 1582,
 - France between 9 Dec 1582 and 20 Dec 1582
 - Hungary between 21 Oct 1587 and 1 Nov 1587
 - Prussia between 22 Aug 1610 and 2 Sept 1610
 - Denmark between 18 Feb 1700 and 1 Mar 1700
 - Britain between 2 Sep 1752 and 14 Sep 1752
 - Greece between 9 Mar 1924 and 23 Mar 1924
 - Russia between 31 Jan 1918 and 14 Feb 1918
 - Turkey between 18 Dec 1926 and 1 Jan 1927?
- Nothing. Each country's calendar has a gap when it adopted the new Gregorian system

What the Renaissance knew

- Cesare Ripa's "Iconologia" (1593), a book on allegories

ICONOLOGIA DI CESARE RIPA PERVGINO.

Cavaliere di SS. Maurizio, e Lazzaro.
LIBRO PRIMO.
ABONDANZA.



le è riputata la carestia, che di quella è contraria.
Ha la ghirlanda de' fiori, perche sono fiori de' frutti che fanno l'Abondanza me fupera, & autori, possono anco significare l'allegrezza, & le delizie di quella vite compagne.
Il cornucopia, & i fregi dall'oro del suo vestimento, sono colori proprii essendo che il bel verdopaur della campagna molti fertili produzioni; & l'ingiallire, la maturazione delle biade, & de' frutti, che fanno l'Abondanza.
Il cornucopia della donna per la favola della Capia Amica, raccontata da Hermogene nel lib. della Fingia si come riferisce Natale Conte nel 7. libro delle sue Meteorologie al cap. 2. di Aibeloo, & per quello che Ouidio fa dire del detto Acheloo sotto figura di Toro, nel lib. 5. delle Trasformazioni, e roaniffico segno dell'Abondanza, dicendo così.

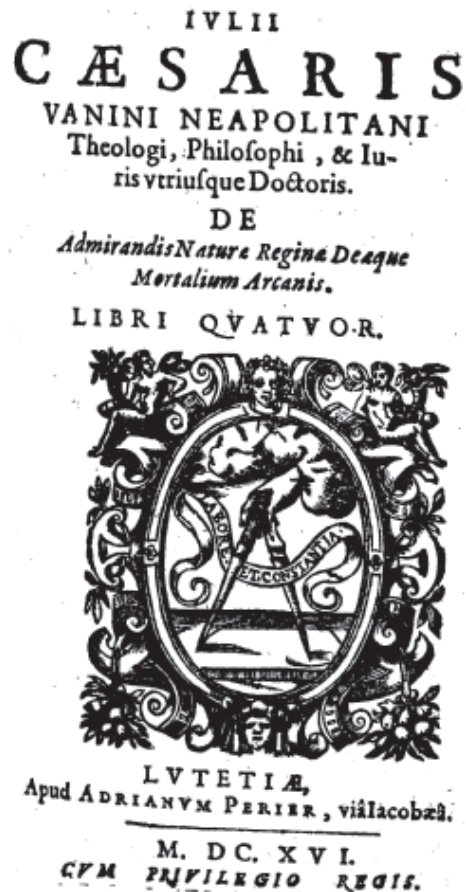
DONNA gratiosa, che hauendo d'una bella ghirlanda di vaghi fiori ricinta la fronte, & col bellissimo di color verde, ricamato d'oro, con la destra mano tenga il cornucopia della donna pieno di molti & diuersi frutti, uoci oliue, & altri, & con sinistro braccio stringa un fascio di spighe digrano, di ragnoli, panico, legumi, & somiglianti, dal quale si vederanno molte di dette spighe vlcio cadere, & sparte anco per terra.
Bella, & gratiosa si debbe dipingere l'Abondanza, si come se la buona, & desiderata da ciacheduno, quanto buona, & abominosa.

*Nature, & loc. puniti. & flosi nobres epulanti
Sacrarborum diuersi, uoci bina, & p. cornucopia.
Et perche l'Abondanza si dice Copia, per mostrarla, così la rappreseniamo, che il braccio sinistro habbia, come il detto la sua cornucopia, & d'auriuggio, essendo che parte di quel le spighe si spargano per terra.
In prescriptum Abundantia figuratur.
Dionysius, & Bacchus.
Aspice terrarum sitientis, unguis canopos
Ad multiplices campos, anthe bonos, & Ceres.
Pomum non vltio carpitur, panice rami.
Et fronsa vitis, plebs huius, & radi.
Cerebarum p. n. greeci huius, & flos huius.
Hinc pinguis iudicat vinona, vultu lacu.
A. Sylva*

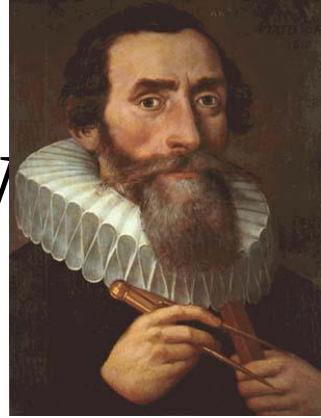


What the Renaissance knew

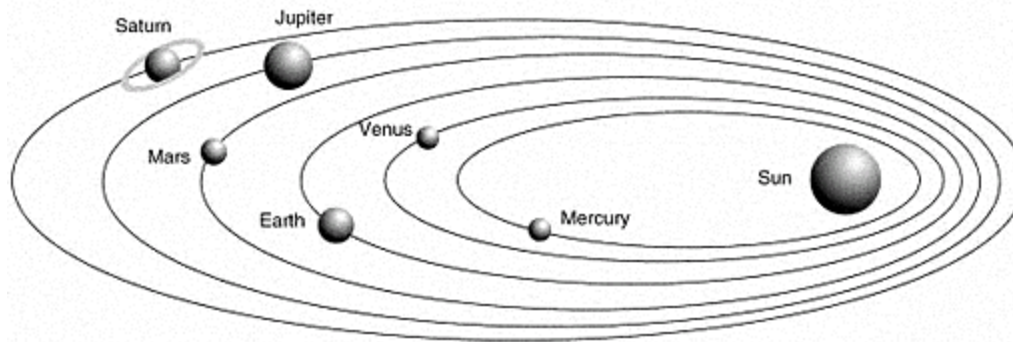
- Lucilio Vanini (1616)
 - First atheist (burned at the stakes)



What the Renaissance knew

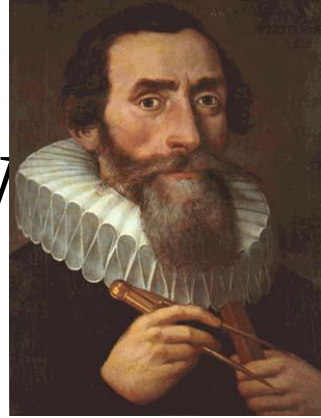


- Johannes Kepler (1619, Germany)
 - Laws of planetary motion
 - Planets move in ellipses (motion is not uniformly circular)
 - Planets describe equal areas in equal times
 - The square of a planet's periodic time is proportional to the cube of its mean distance from the sun
 - Orbiting bodies move along ellipses



What the Renaissance knew

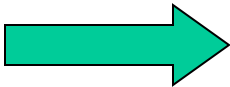
- Johannes Kepler (1619, Germany)
 - Ellipses not circles for astral bodies
 - The heavens are a machine
 - Harmony of the universe is in God's mind
 - The same harmony is reflected in music
 - The Earth is a living being



What the Renaissance knew

- Johannes Kepler (1619)

Newton:

$$\frac{mM}{dd} = F = ma = m \frac{v}{t} = m \frac{s}{tt} = km \frac{d}{tt}$$




$$\frac{mM}{dd} = km \frac{d}{tt} \quad \rightarrow \quad M = k \frac{ddd}{tt} \quad \rightarrow \quad tt = Kddd$$

What the Renaissance knew

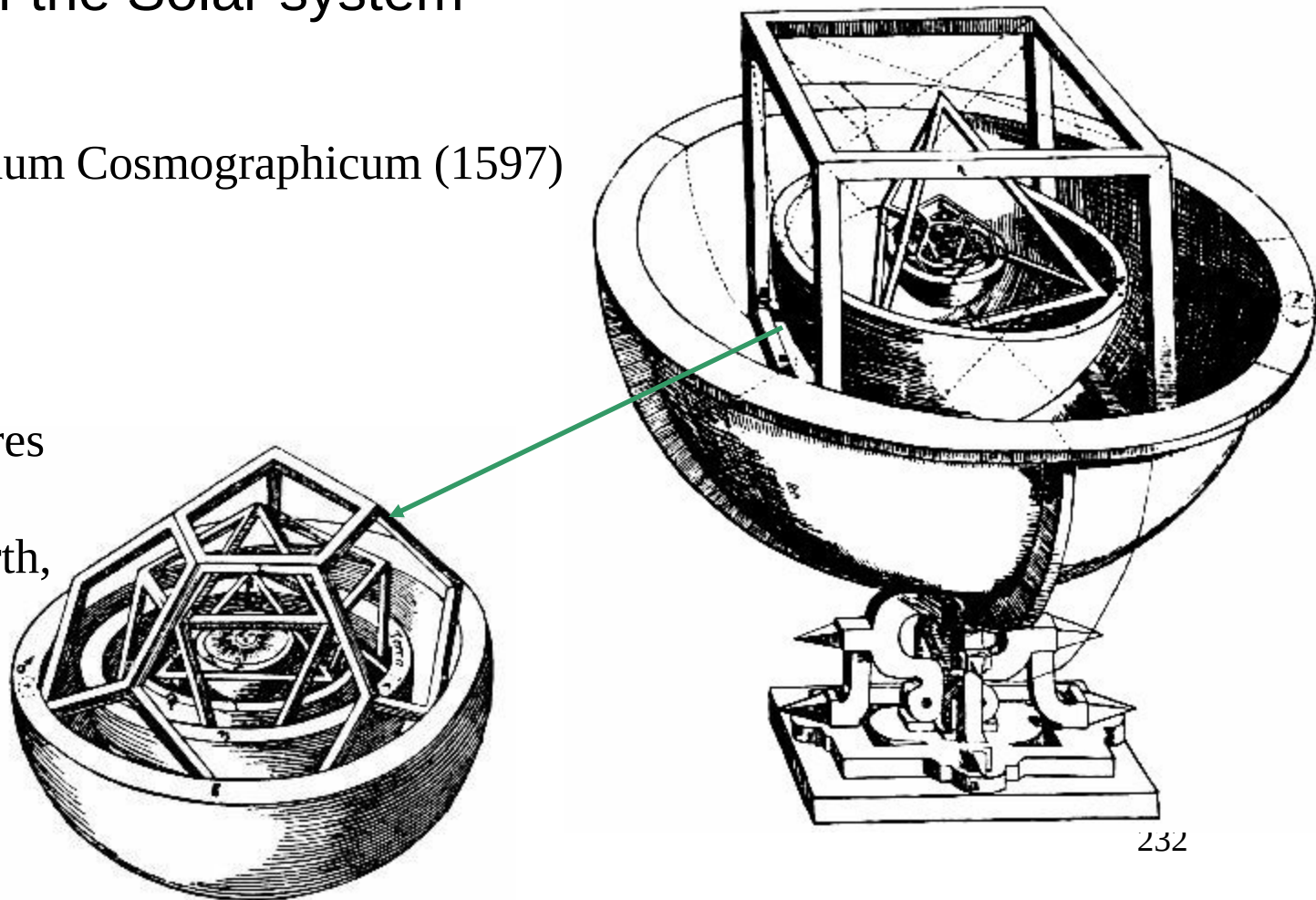
- Johannes Kepler (1597, Germany)
 - Model of the Solar system
 - One Platonic solid fits between each pair of planetary spheres
 - The outer sphere is that of Saturn; inside it is the sphere of Jupiter
 - There can be only six planets because Euclid had proved that there are only five Platonic solids
 - Wrong, but emphasis on beauty, elegance and simplicity

What the Renaissance knew

- Johannes Kepler (1597, Germany)
 - Model of the Solar system

Mysterium Cosmographicum (1597)

Closeup of the spheres
of inner planets,
Mercury, Venus, Earth,
and Mars



What the Renaissance knew

- Johannes Kepler (1597, Germany)
 - Whats moves the planets? A force. Which force? A magnetic force.
 - Magnetic theory of planetary motion (the Sun and the planets are magnets)
 - Natural state is rest: a body not subject to forces must be at rest
 - Motion can only be maintained by the work of an external motor
 - The universe is a sphere of a finite size (the ancient Greek view)

What the Renaissance knew

- Johannes Kepler (1597, Germany)
 - "Ad vitellionem Paralipomena" (1604): theory of vision

What the Renaissance knew



- Francis Bacon (1620)
 - “Idols” keep humankind from knowing more than it could
 - Idols of the Tribe: distortions due to the physical limitations of the human mind
 - Idols of the Cave: distortions due to education
 - Idols of the Marketplace: distortions due to ambiguous language
 - Idols of the Theatre: distortions due to ideologies, philosophies, etc

What the Renaissance knew



- Francis Bacon (1620)
 - Science must be based on experiments
 - The experiments must be carefully designed because our senses deceive us
 - Indifference towards the language of mathematics
 - Very influential on the development of science in Britain

What the Renaissance knew



- Francis Bacon (1620)
 - Truth must be found via objective, unbiased, empirical observation, and inductive accumulation of evidence
 - Induction vs deduction
 - Materialism

What the Renaissance knew



- Francis Bacon (1620)
 - Knowledge is not evil (like the Church implies) but good
 - Knowledge is power
 - Goal of science is to control the world (“how to command nature itself”), i.e. technology
 - Bacon marries science and technology

What the Renaissance knew



- Francis Bacon (1620)
 - Three inventions changed the world: the printing press, gunpowder and magnetic compass
 - *...it is well to observe the force and virtue and consequences of discoveries; and these are to be seen nowhere more conspicuously than in those three which were unknown to the ancients, and of which the origin, though recent, is obscure and inglorious; namely, printing, gunpowder, and the magnet. For these three have changed the whole face and state of things throughout the world; the first in literature, the second in warfare, the third in navigation...*

What the Renaissance knew



- Francis Bacon (1620)
 - “The Advancement of Learning” (1605) is the first philosophical/scientific book that an Englishman can read in English (instead of Latin)

What the Renaissance knew

- Utopias
 - Antonio Francesco Doni's "I Mondi" (1552)
 - Francesco Patrizi's "La Citta` Felice" (1553)
 - Tommaso Campanella: "City of the Sun" (1602)
 - Johann Valentin Andreae: "Christianopolis" (1619)
 - Francis Bacon: "New Atlantis" (1627)
 - Gabriel Plattes: "A Description of the Famous Kingdome of Macaria" (1641)
 - Samuel Gott: "Nova Solyma" (1648)
 - The commune of the Diggers (1649)
 - James Harrington: "The Commonwealth of Oceana" (1656)
 - Daniel DeFoe or John Somers: "The Free State of Noland" (1696)

What the Renaissance knew

- Imaginary voyages
 - Artus Thomas: "L'Isle des hermaphrodites" (1605)
 - Henry Schooten : "The Hairy Giants: Or a Description of Two Islands in the South Sea, Called by the Names of Benganga and Coma" (1671)
 - Joshua Barnes: "Gerania: A New Discovery of a Little sort of People Anciently Discoursed of, called Pygmies" (1675)
 - Denis Vairasse: "The History of the Sevarites or Severambi: A Nation of Inhabiting Part of the Third Continent, Commonly Called, Terræ Australes Incognitæ" (1675)
 - Gabriel de Foigny: "A new Discovery of Terra Incognita Australis" (1676)
 - Aphra Benn: "Oroonoko: or, the Royal Slave" (1688)

What the Renaissance knew

- Imaginary voyages
 - Heliogenes L'Epy: “His Fantastic Voyage, A Voyage into Tartary, Containing a Curious Description of that Country” (1689)
 - Francis Lee: “Antiquity Revived , or the Government of a certain Island antiently called Astreada” (1693)
 - Ambrose Evans: “The Adventures, and Surprizing Deliverances, of James Dubourdieu, and His Wife” (1719)
 - Simon Berington: “Memoirs of Sigr Gaudentio Di Lucca” (1737)
 - Ludvig Holberg: “The Underground Travels of Niels Klim” (1741)
 - John Holmesby: “The Voyages, Travels, and Wonderful Discoveries of Capt. John Holmesby” (1757)

What the Renaissance knew

- Novels based on imaginary voyages
 - Henry Neville: “The Isle of Pines” (1668)
 - Francois Fenelon: “Telemaque” (1699)
 - Daniel Defoe: “Robinson Crusoe” (1719)
 - Jonathan Swift: “Gulliver's Travels” (1726)

What the Renaissance knew

- Archbishop James Ussher: “Sacred Chronology” (1620)
 - According to the Bible, the Earth was created in 4004 B.C.

What the Renaissance knew

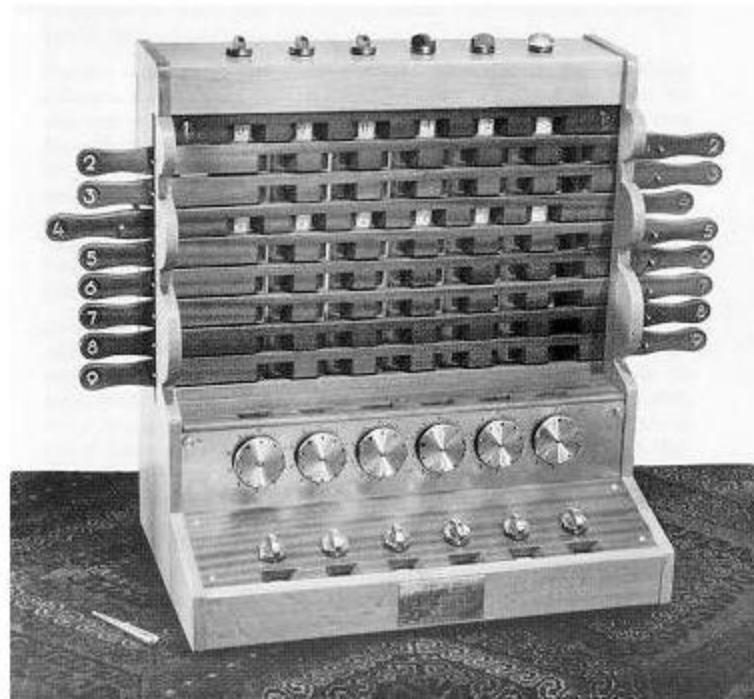
- Christopher Marlowe
 - Dr Faustus: sells his soul to the devil in order to dominate the world

What the Renaissance knew

- Jakob Bohme (1624)
 - God is the soul of the world
 - God's goal was to restore the world to a state of grace
 - The history of the world is the history of God struggling to perfect himself
 - The Fall of humans was necessary for God to achieve a higher level of self-awareness
 - This self-perfecting process works through resolution of opposites (such as good and evil)
 - Proto-dialectics

What the Renaissance knew

- Wilhelm Schickard (1624)
 - First mechanical calculator



What the Renaissance knew

- Hugo Grotius' “Rights of War and Peace” (1625)
 - Founder of international law: nations should have the same right to justice under international laws that individuals have under national laws
 - All states (regardless how small) have the same rights
 - Lawfulness of war
 - The primacy of natural law

What the Renaissance knew

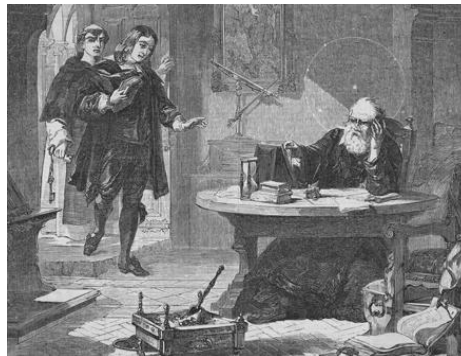


- Galileo Galilei (1632)
 - Focus on falling bodies and projectiles, indirectly influenced by the technology of cannons

What the Renaissance knew



- Galileo Galilei (1632)
 - Greeks: Nature can be explained
 - Galileo: Only explanations based on experimental verification are valid
 - Mathematization of mechanics
 - As mechanics becomes more and more difficult to discuss, the language of philosophy is no more enough and the language of mathematics takes over.



John Milton visiting Galileo

What the Renaissance knew

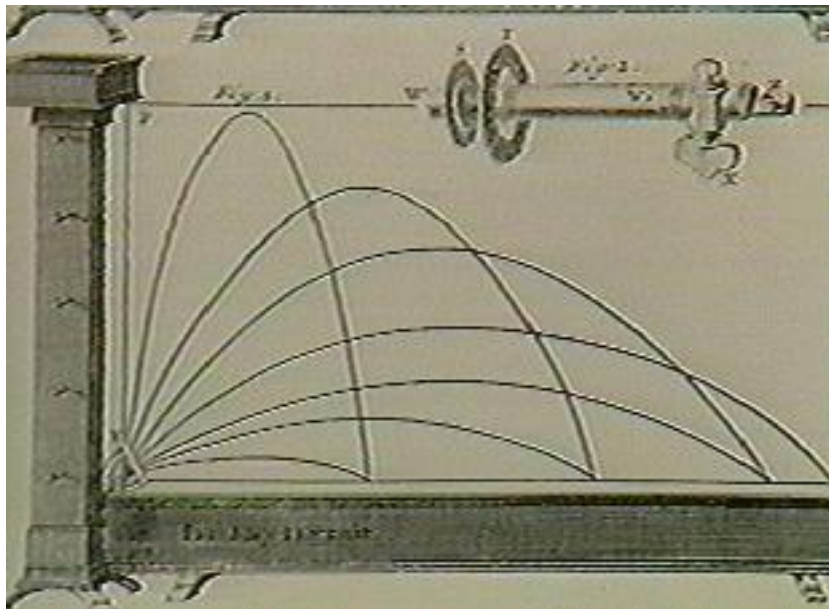
- Galileo Galilei (1632)
 - Atomistic theory of matter
 - There is a reality independent of anyone perceiving it, and our senses represent it...
 - ...but our senses cannot access it directly (only through the sensations)

What the Renaissance knew

- Galileo Galilei (1632)
 - A body in free motion does not need any force to continue moving
 - If a force is applied, then what will change is the acceleration, not the velocity
 - Linear uniform motion as the natural motion of all objects (as natural as the circular motion of astral objects)
 - The constant application of a force results in acceleration (constantly increasing velocity)
 - Acceleration is the same for all free-falling objects

What the Renaissance knew

- Galileo Galilei (1632)
 - Falling bodies move along parabolas
 - The law of parabolic fall: the distance traveled by a falling body is directly proportional to the square of the time it takes to fall



$$X = a t^2$$

What the Renaissance knew

- Galileo Galilei (1632)
 - A “body” as a geometrical abstraction
 - How to unify horizontal and vertical motion
 - The force that keeps the moon orbiting around the Earth and the force that causes objects to fall are the same force

What the Renaissance knew

- Galileo Galilei (1632)
 - Celestial objects are not perfect spherical bodies
 - The Heavens are not static and perfect, but subject to forces and continuously changing
 - The same natural laws apply on Earth and in the Heavens
 - Matter is the same everywhere

What the Renaissance knew

- Galileo Galilei (1632)
 - Relativity: All physical laws are the same regardless of the observer's state of motion as long as the velocity of the observer does not change (there is no local way of telling uniform motion from rest)
 - We do not perceive the speed of the Earth around the Sun because of Galileo's relativity

What the Renaissance knew

- Galileo Galilei (1632)
 - Conservation of energy: energy changes in quality (from potential to kinetic) but is always conserved

What the Renaissance knew

- Galileo Galilei (1632)
 - Greeks: The behavior of Nature can be explained (intuitive explanations)
 - Aristoteles: Motion is the basis of the explanation
 - Copernicus: The explanation must be simple
 - Galileo: Any explanation is good if it satisfies an experimental test ,i.e. provides correct predictions (non-intuitive explanations are acceptable)
 - (Newton: The world is a mechanism)

What the Renaissance knew

- Galileo Galilei (1632)
 - The air has weight

What the Renaissance knew

- Galileo Galilei (1632): not always right!
 - Not interested in what causes bodies to fall but simply in how they fall
 - Law of falling bodies (not extended to bodies rolling down an inclined plane)
 - A force is proportional to the speed (false)
 - Tides are caused by the Earth's motion around the Sun

What the Renaissance knew

- Galileo Galilei (1632): not always right!
 - The universe is a sphere of a finite size (the ancient Greek view)
 - Wrong idea of inertia: natural motion is circular (ancient Greek view)
 - Principle of relativity: if all bodies move the same way, they cannot observe their motion (false in general, true only in the case of uniform rectilinear motion)

What the Renaissance knew

- Galileo Galilei (1632)
 - "Dialogo sopra i due Massimi Sistemi del Mondo" (1632) defends Copernicus
 - "Nuncius Sidereus" describes the discoveries he made with the telescope: the Moon's surface has irregularities just like the Earth, the Milky Way is a cluster of stars, Jupiter has moons...
 - Atomism: infinite number of infinitely small atoms separated by infinite numbers of vacuola
 - "The book of nature is written in the language of mathematics"

What the Renaissance knew

- Galileo Galilei (1632)
 - Galileo's trial marks the moment that the harmony created by Thomas Aquinas ends and the conflict between science and religion begins.

What the Renaissance knew

- Isaac Beeckman (1637, rediscovered in 1905)
 - A law of the falling bodies
 - A law of inertia: a body left to itself continues to move at the same speed if it is going straight and continues to circle if it is circling
 - Atomism

What the Renaissance knew

- Giovanni Battista Baliani (1638)
 - Ancient dilemma: how can uniformly variable motion arise from constant gravity when in every other case a constant force generates constant speed?
 - Baliani's hypothesis: acceleration, not velocity, is the effect of a force
 - Mass vs weight

What the Renaissance knew

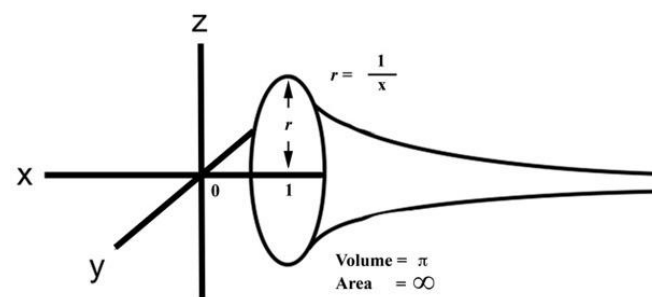
- Evangelista Torricelli (1644)
 - Fulfills Galileo's program of the mathematization of mechanics
 - Axiom: "Two connected bodies cannot start moving by themselves if their common center of gravity does not move downwards"
 - Fluid dynamics: determines the speed of a liquid flowing under the force of gravity out of an orifice
 - The barometric phenomenon is due to atmospheric pressure
 - Hydrostatic and aerostatic phenomena are identical

What the Renaissance knew

- Infinites and infinitesimals
 - If a line segment is composed of an infinite number of zero-width infinitesimal points, how does it have a finite length?

What the Renaissance knew

- Infinites and infinitesimals
 - Galileo Galilei: "Discorsi e dimostrazioni matematiche intorno a due nuove scienze" (1638)
 - Evangelista Torricelli: "Opera Geometrica" (1644)
 - Torricelli's trumpet: surface area is infinite, but volume is finite
 - Bonaventura Cavalieri: "Geometria indivisibilibus continuorum nova quadam ratione promota" (1635)



Torricelli's Trumpet

What the Renaissance knew

- Infinites and infinitesimals
 - The Jesuits ban infinitesimals in Italy
 - John Wallis: “Arithmetica Infinitorum” (1656)
 - the symbol ∞ for infinity:



What the Renaissance knew

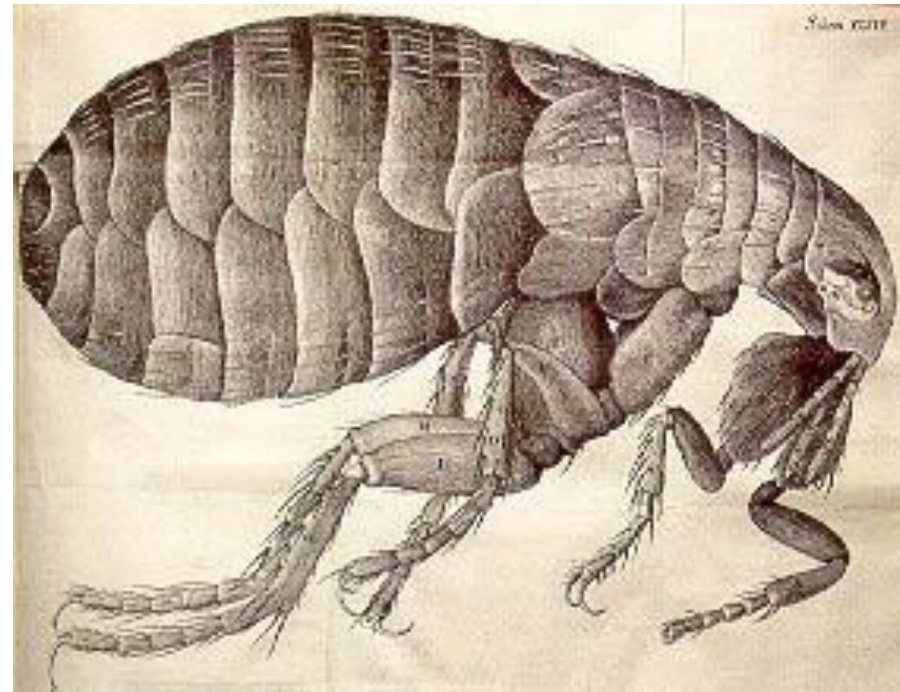
- Telescope
 - Probably invented in 1600 in Holland
 - Transition from naked-eyed observation to device-mediated observation
 - 1610: Galileo points a telescope to the heavens (he peeks into God's realm)
 - The Church had no problem with Copernicus' mathematical theory but has a problem with Galileo spying God
 - The telescope reveals many more stars that the human eye cannot see

What the Renaissance knew

- Microscope
 - Probably invented in Germany
 - Robert Hooke's "Micrographia" (1665): the cell
 - Antonj van Leeuwenhoek sees microorganisms (1674)



Hooke's microscope



What the Renaissance knew

- Seeing inside the human body/ Medicine
 - Medieval medicine: theory of the four humors (fluids) whose imbalance causes disease

What the Renaissance knew

- Seeing inside the human body/ Medicine
 - Paracelsus (16th c)
 - Ferocious attacks on Galen
 - “Opus Paragranum” (1530) - disease is caused by external agents and chemistry can be used to heal the body
 - All matter is animated by the "archeus" (a spiritual force) and everything is made of three principles
 - But also magic and astrology...
 - “Man is a microcosm, or a little world, because he is an extract from all the stars and planets of the whole firmament, from the earth and the elements; and so he is their quintessence.”
 - Paracelsus discovers "alohaest", a miraculous substance

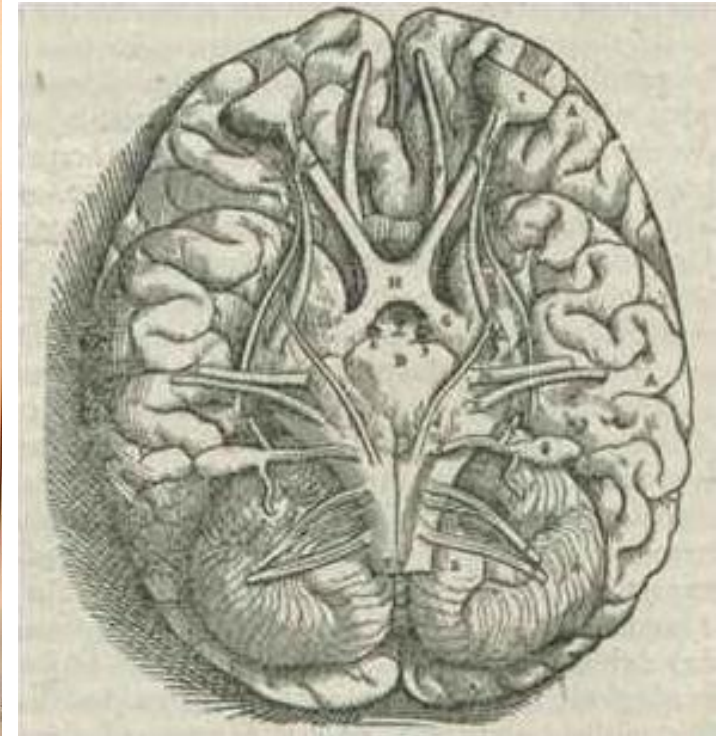
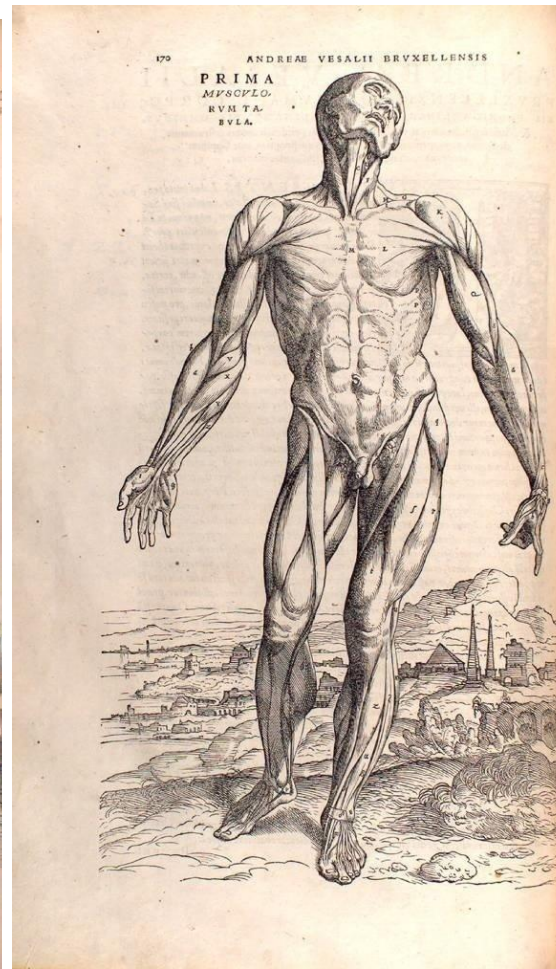


What the Renaissance knew

- Seeing inside the human body/ Medicine
 - Jean Fernel: “De Naturali Parte Medicinæ” (1542)
 - medicine founded on science and not on superstition
 - Anatomy: still Galen’s manual of the 2nd c AD!
 - A number of pneuma control the body
 - Leonardo studies anatomy

What the Renaissance knew

- Seeing inside the human body
 - Andreas Vesalius' "Fabrica" (1543)



What the Renaissance knew

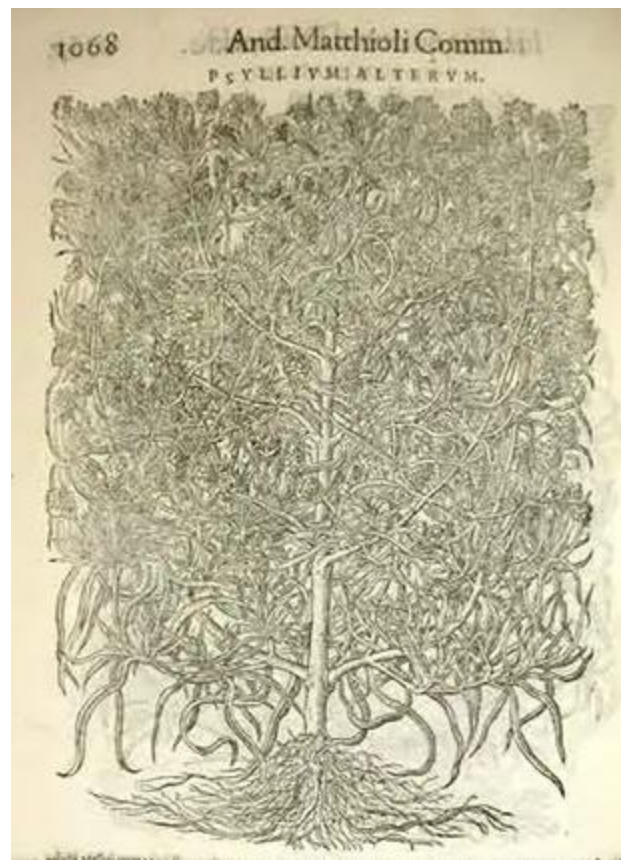
- Seeing inside the human body/ Medicine
 - William Harvey explains the circulation of blood and that the heart is nothing but a pump, not the site of thought (1628)
 - Santorio's "Ars de Medicina Statica" (1612)
 - Thomas Willis' "The Anatomy of the Brain and Nerves" (1664), beginning of "neurology" (Willis coined the term)
 - Anton van Leuwenhock discovers spermatozoa (1677)
 - Marcello Malpighi founds microscopic anatomy (17th c)

What the Renaissance knew

- Seeing inside the human body/ Medicine
 - Gaspare Aselli: The lymphatic system 1622
 - William Harvey: The cardiovascular system 1628

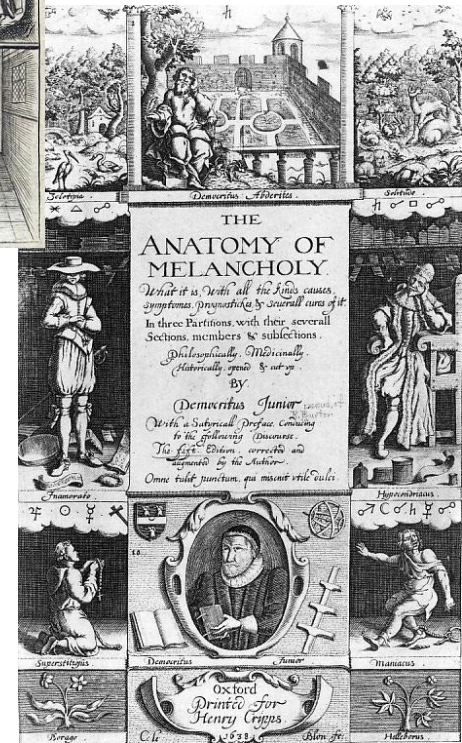
What the Renaissance knew

- Medical Botany
 - Pietro Andrea Mattioli's translation of Dioscorides' *De Materia Medica* (1544) and his "Commentarii" (1554)



What the Renaissance knew

- But also witchcraft, magic, etc
 - Joseph Glanvill: “Saducismus triumphatus” (1681)
 - ...
- And melancholia
 - Timothy Bright: “A Treatise of Melancholie” (1586)
 - Robert Burton: “The Anatomy of Melancholy” (1621)



What the Renaissance knew

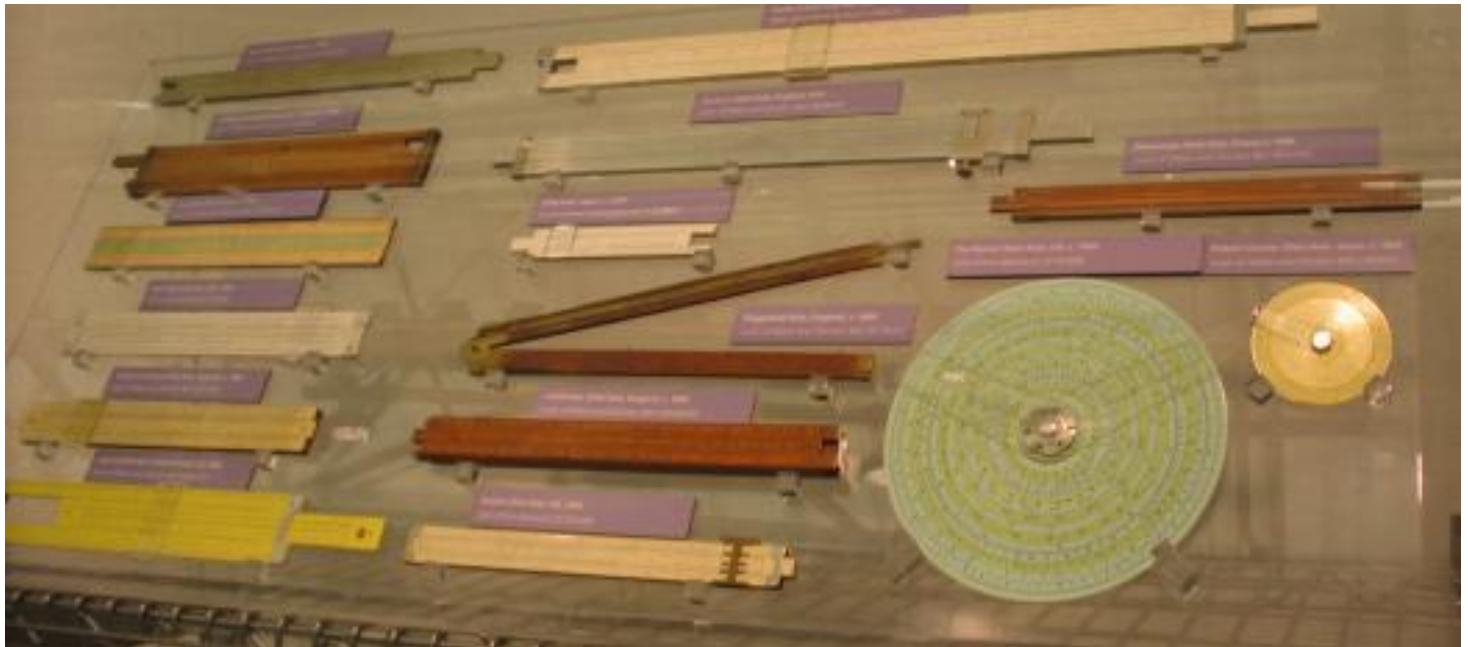
- Mechanical calculators
 - The first mechanical calculating machine, by Wilhelm Schickard (1620)



(Computer History Museum, Mountain View)

What the Renaissance knew

- Mechanical calculators
 - William Oughtre invents the slide rule, a mechanical analog computer (1622)



What the Renaissance knew

- Mechanical calculators
 - Wilhelm Schickard invents a “calculating clock” (Germany, 1623)



What the Renaissance knew

- Mechanical calculators
 - Moreland's multiplying and adding instruments
 - Caspar Schott's Cistula
 - René Grillet's machine arithmétique
 - Claude Perrault's rhabdologique

What the Renaissance knew

- Blaise Pascal (1632)
 - Ptolemy, Brahe and Copernicus are equivalent theories of planetary motion
 - "Treaty of Equilibrium of Liquids and Weights of the Masses of Air" (1654): equivalence of hydrostatic and aerostatic phenomena (Torricelli's theory)
 - Mechanical adding machine (1642)
 - Atmospheric pressure (1648)
 - Mathematical theory of probability (1654)



Pascal's "Calculating Machine" (1642)
(Museum of Science, London)

What the Renaissance knew

- Blaise Pascal (1662)
 - The original sin caused humans to lose certainty and absolute knowledge: now they live in doubt and ignorance
 - Revelation can be comprehended only by faith
 - The value of eternal happiness is infinite: although the probability of gaining such happiness by religion may be small it is infinitely greater than by any other means

What the Renaissance knew

- Blaise Pascal (1662)
 - Primacy of emotion in human behavior
 - “The heart has its reasons which reason does not know. It is the heart which perceives God and not the reason.”

What the Renaissance knew

- Pierre de Fermat (1637)
 - No three positive integers a , b , and c can satisfy the equation $a^n + b^n = c^n$ for any integer value of n greater than two

What the Renaissance knew

- Spreading of knowledge in the 17th century
 - Marin Mersenne's correspondence (Descartes, Pascal, Hobbes, Torricelli, Huygens, Galileo)
 - Samuel Hartlib's correspondence
 - Nicolas-Claude de Peiresc's correspondence
 - Ismael Boulliau's correspondence
 - Henry Oldenburg's correspondence
 - The Taxis postal system (Italy, Austria, Germany, Spain, France, Flanders) with monopoly granted by the German emperor in the lands of the Empire
 - The Taxis competitors in France (where no monopoly is granted)

What the Renaissance knew



- René Descartes (1644)
 - Rationalism
 - Mechanicism
 - Reductionism

What the Renaissance knew

- René Descartes (1644)
 - Doubt as the foundation of philosophy
 - All our beliefs based on our sensations can be doubted
 - Everything can be doubted except my own existence: “Cogito ergo sum”
 - Two substances: matter has extension, mind has thought, each has its laws, they communicate via the pineal gland (Dualism)
 - Innate ideas (self-evident truths that do not depend on sensory experience)

What the Renaissance knew



- René Descartes (1644)
 - Equivalence between living and non-living matter
 - Animals are machines
 - Everything material can be reduced to mechanics
 - Human bodies are machines too but the soul is not

What the Renaissance knew

- Descartes (1644)
 - The only qualities of objects that we are sure of are the modes of extension (size, shape, motion, position, duration, number)
 - The sensations that they cause in us (colours, sounds, smells) correspond to real qualities of the object but we cannot know what the real qualities are, only the sensations that they provoke in us

What the Renaissance knew

- Descartes (1644)
 - What is unique about humans is thought
 - The mind is capable of representing the world of objects
 - The mind is a stage where ideas are illuminated by the inner light of reason (Cartesian theater)

What the Renaissance knew

- Descartes (1644)
 - God is the perfect thing
 - Existence is one of the perfections
 - Thus God exists

What the Renaissance knew

- Descartes (1644)
 - Mathematics is certain knowledge (what cannot be doubted), from which other certain knowledge can be derived
 - All human knowledge can be unified by the use of exact reasoning
 - The scientific method is to analyze a problem, decompose it into component parts, explain each component and then rebuild the whole

What the Renaissance knew

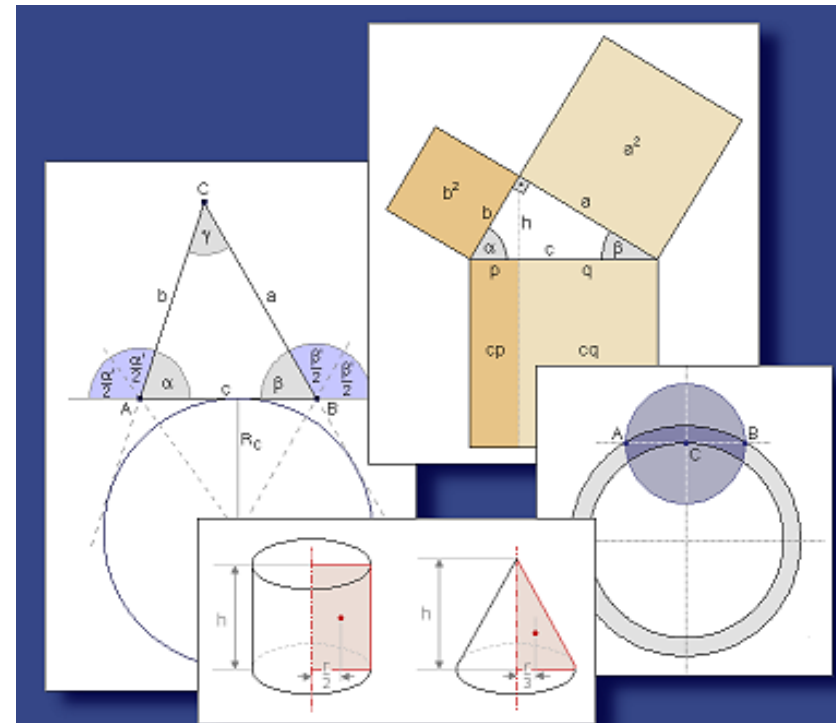
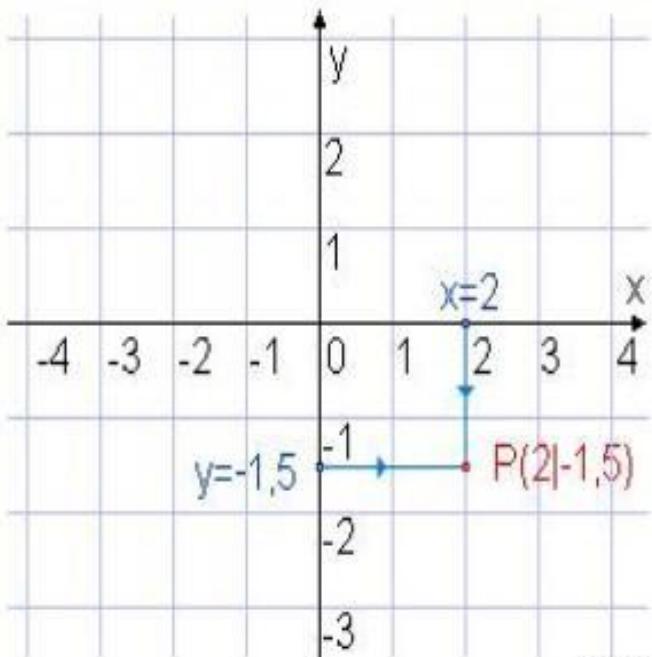
- Descartes (1644)
 - The universe is a mechanism
 - God is the clockmaker (determines the law that drive the mechanism)
 - The current universe evolved mechanically out of an earlier stage
 - God does not mold the individual elements of nature at any point in time but only sets in motion the laws of nature
 - The Earth might have been formed from a star that cooled downPlanets revolve around the sun because it is surrounded by a vortex

What the Renaissance knew

- Descartes (1644)
 - We can arrive at “useful knowledge ... by which, knowing the force and action of fire, water, air the stars, the heavens, and all the other bodies that surround us... we might also apply them in the same way to all the uses to which they are suited, and thus render ourselves the lords and possessors of nature.”

What the Renaissance knew

- Descartes (1644)
 - Analytic geometry: isomorphism between algebra and geometry i.e. use algebra to solve geometry
 - Cartesian coordinates



What the Renaissance knew

- Descartes (1644)
 - Science is mathematical
 - Discourse: four guiding principles for scientific research
 - Symbolic algebra
 - Synthesis of science, philosophy and religion
 - First global interpretation of nature since Aristotle
 - Identity of matter and space
 - The world is infinite just like space
 - Matter is infinitely divisible just like space (no atoms)

What the Renaissance knew

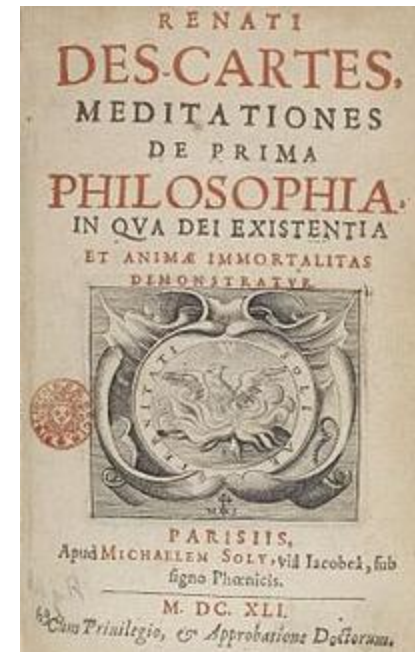
- Descartes (1644)
 - Planets move because of vortices around the Sun
 - There are vortices around all stars
 - Some vortices revolve around other vortices
 - Descartes' arguments are rarely mathematical: logical relations, not mathematical relations
 - Discouraged by Galileo's trial to publish "Le Monde", his defence of Copernicus

What the Renaissance knew

- Descartes (1644)
 - Conservation of total momentum
 - Centrifugal force

What the Renaissance knew

- Descartes (1644)
 - The Cartesian era
 - Dichotomy of reality into inner experience (spirit) and outer world (matter)
 - Religion studies the spirit, science the matter (“Meditations on First Philosophy”)
 - Descartes indirectly brokered a truce between religion and science, by assigning sentient life to religion and matter to science



What the Renaissance knew

- Descartes (1644)
 - The Cartesian era
 - Reductionism
 - Civilizations were mostly holistic for thousands of years before the Cartesian revolution
 - Reductionism: The whole is the sum of its parts
 - One can simplify a problem (reduce the complexity) by dividing the system into its parts
 - Mathematical model of physical systems
 - The interaction with the environment is negligible

What the Renaissance knew

- Descartes ("Treatise on Light", 1633)
 - We sense what changes: we only sense what causes a change in our sensory system
 - If something doesn't change, we'll never sense it
 - That doesn't mean that it doesn't exist
 - Not all things around us are sensible (perceivable)
 - "Those that are there most of the time can be sensed the least, and those that are always there can never be sensed at all"

What the Renaissance knew

- Descartes ("Treatise on Light", 1633)
 - The vacuum does not exist
 - The universe is full of matter in different states
 - Matter moves other matter
 - There are an infinite number of vortices

What the Renaissance knew

- Juana Ines de la Cruz (Mexico, 1648): "Respuesta a Sor Filotea" (1691)
 - First feminist treatise

Frontispiece to the Authorized Version of the Bible (1611)



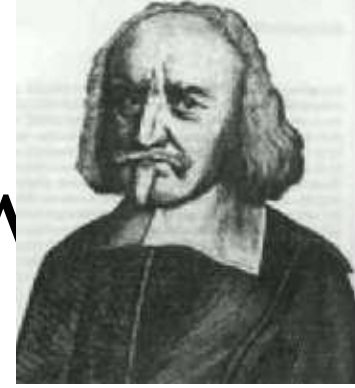
Frontispiece to the
Leviathan



John Speed's
Theatrum Imperii Magnae Britanniae

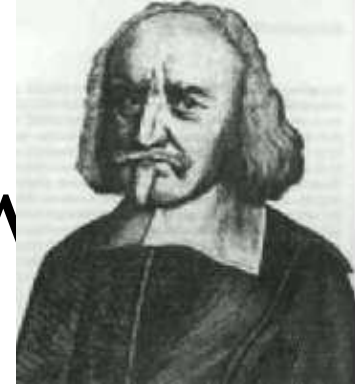


What the Renaissance knew



- Thomas Hobbes (1651)
 - Materialism
 - Only matter exists
 - All knowledge comes from the senses
 - Nature is a mechanism
 - The motion of living beings is due to a force to eschew pain and a force to desire pleasure
 - The human body is a mechanism
 - Human behavior is caused by material phenomena, and is controlled by the competing motivations of appetite and aversion: no free will

What the Renaissance knew



- Thomas Hobbes (1651)
 - Materialism
 - Embraces the mechanistic cosmology of Galileo as a replacement for Aristotelian cosmology
 - Humans are machines moved by a set of desirable situations and a set of undesirable situations
 - Science is an instrument to control nature
 - The soul is part of the body (it represents its “vital” quality)
 - There is no absolute definition of good and evil: good is what gives pleasure, and evil is what gives pain

What the Renaissance knew

- Hobbes (1651)
 - Force is transmitted by contact between bodies
 - There is a substance filling the void between bodies:
 - God is that substance

What the Renaissance knew



What the Renaissance knew

- Thomas Hobbes (1651)
 - Human nature is evil. Good arises with society.
 - Human nature is inherently selfish and violent, bound to endless civil strife ("war of all against all")
 - The state provides stability and security for the people
 - Peace and security are more important than liberty and rights
 - The laws of the country (designed to maintain peace and security) are the equivalent of the laws of nature (designed to maintain order)

What the Renaissance knew

- Thomas Hobbes (1651)
 - The law is the command of the sovereign
 - The sovereign is the best interpreter of God's will
 - Monarchy is the best form of government
 - Religion is a system of law, not a system of truth

What the Renaissance knew

- **New Amsterdam, 1651**



What the Renaissance knew

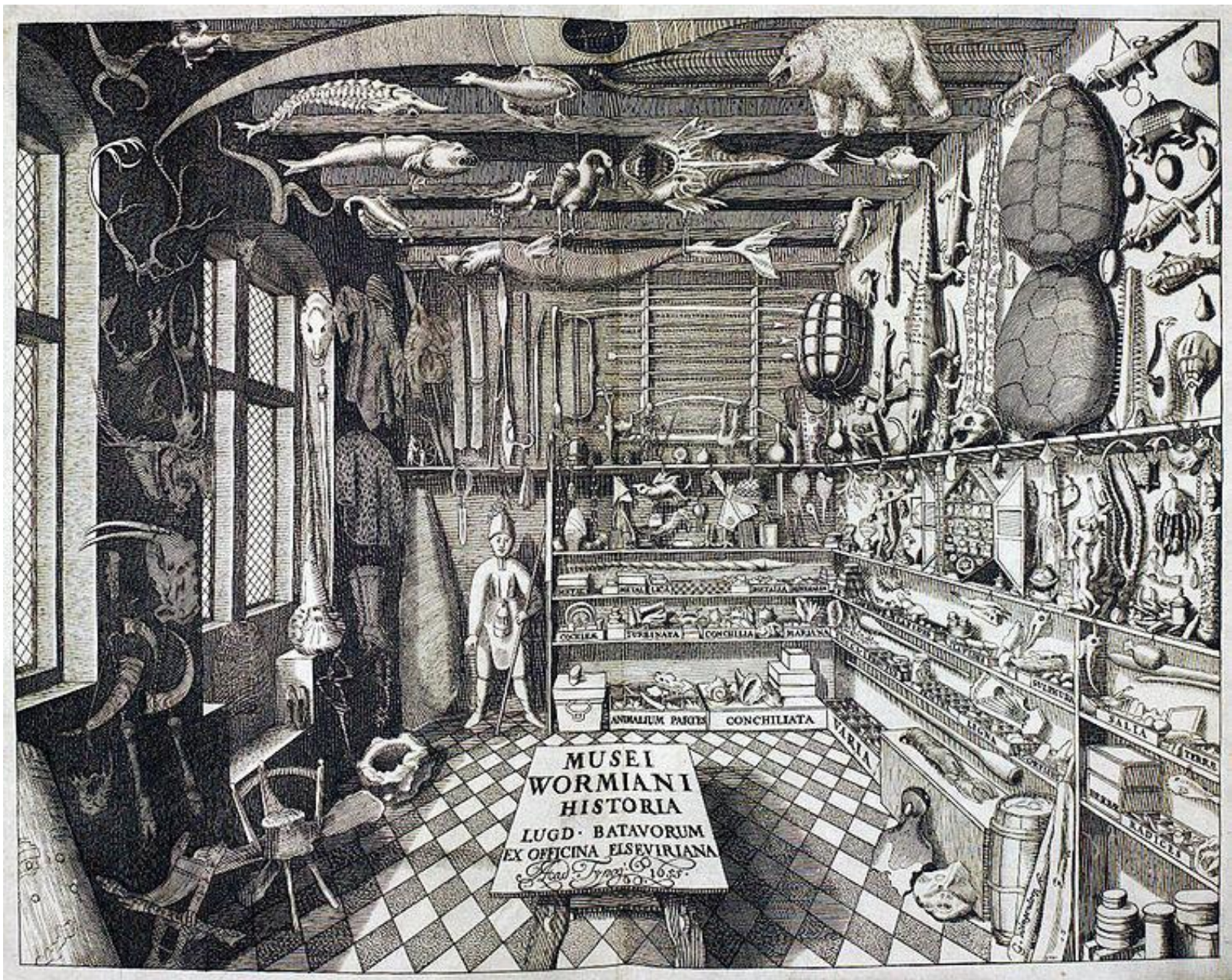
- Air Pressure (towards the steam engine)
 - 1650: Otto von Guericke invents the air pump
 - 1653: Blaise Pascal's "The Equilibrium of Liquids"
 - 1654: Otto Von Guericke's application of air pressure to pistons
 - 1655: Edward Somerset's "The Century of Inventions"

What the Renaissance knew

- Henry More (1653)
 - Critique of Cartesianism and neoplatonism
 - A spirit of nature (an emanation of God) directs the movement of all things
 - All things lie in space, which is infinite extension, which is also an emanation of God

What the Renaissance knew

- Pierre Gassendi (1655)
 - Epicurean atomism
 - Matter is made of indivisible atoms, separated by vacua
 - There are many different kinds of atoms
 - The world lies in the middle of an infinite vacuum
 - Mental processes correspond to physical processes in the brain
 - Brain and soul seem to interact, but their harmony was preset by God



What the Renaissance knew

- Christiaan Huygens (1656)
 - 3500 BC Sundial
 - 1400 BC, Egypt: Water clock (Clepsydra)
 - ?: Hourglass
 - 1335 AD: Mechanical clock
 - 1510: Spring-powered clock by Peter Henlein (Nurnberg)
 - 1525: fusee by Jacob Zech (Prague)
 - 1641: Vincenzo Galilei's pendulum
 - 1656: Pendulum by Christian Huygens (first weight-driven clock with a pendulum)

What the Renaissance knew

- Christiaan Huygens (1673)
 - Studies uniform circulation motion and derives the centrifugal force
 - Applies it to pendulum clocks
 - Theory of impact ("De motu corporum ex percussione", 1667) and conservation of total kinetic energy
 - Theory of gravity

What the Renaissance knew

- Christiaan Huygens (1678, published in 1990)
 - Wave theory of light (vs Newton's corpuscular theory): light is a wave and it propagates through an invisible medium (the “ether”)

What the Renaissance knew

- Clocks
 - Portable clocks become ubiquitous
 - The pendulum replaces the spring
 - Precise techniques (ie. Machines) are required to manufacture accurate clocks
 - Mass-scale manufacturing requires machines
 - Clockmaking drives the invention of the metal lathe (16th c) for gears and screws

What the Renaissance knew

- Portable clocks (watches)
 - Clockmaking drives the division of labor (makers of spring, needle, pendulum, etc, engravers, painters, etc)
 - The medieval clock was big enough that it could be built by a blacksmith (who would build it on site). The renaissance clock is small and cannot be built by a blacksmith.
 - 1544: First clockmakers' guild (Paris)
 - 1550: Persecution of protestants causes French and Dutch clockmakers to migrate to Switzerland and England
 - Thirty-years war (1618-48) causes German clockmakers to disperse throughout Europe

What the Renaissance knew

- The spring-driven clock that can be moved (instead of the weight-driven clock that cannot be moved but is more accurate)
 - 1510: Spring-powered clock by Peter Henlein (Nuremberg)
 - 153#: The fusee by Jacob Zech (Prague)
 - 16th century: both portable watches and mantel clocks
 - 1660s: Robert Hooke invents a seafaring clock that uses springs instead of weights to be independent of gravity

What the Renaissance knew

- Jacquemarts for clocks
 - Hans Schlottheim in Augsburg (16th-17th c)
 - Isaac and Josias Habrecht : the Salzburg clock (1574)
 - Jacob Lovelace in England (17##)
 - Henry Bridges: Microcosm (173#)

What the Renaissance knew

- Jacquemarts for clocks
 - Hans Schlottheim's Mechanical Galleon (1585)



What the Renaissance knew

- The pendulum clock (that uses a pendulum as the weight)
 - Leonardo
 - 1641: Galileo's pendulum-driven clock (built by his son Vincenzo)
 - 1656: Pendulum by Christian Huygens (first weight-driven clock with a pendulum)
 - 1680: William Clement's escapement that maintains the swing of the pendulum

What the Renaissance knew

- The problem of determining longitude at sea/ Marine timepieces
 - 1707: Scilly naval disaster
 - 1714: The British government offers a prize for solving the problem
 - 1756: Pierre LeRoy's chronometer
 - 1759: John Harrison's "sea watch", the world's first marine timekeeper that allowed a navigator to accurately assess longitude
 - 1774: Thomas Mudge's marine chronometer, an order of magnitude more accurate



What the Renaissance knew

- Andreas Cellarius: “Harmonia Macrocosmica” (1660)
 - An atlas of everything known about the universe



Plate 13



Plate 14

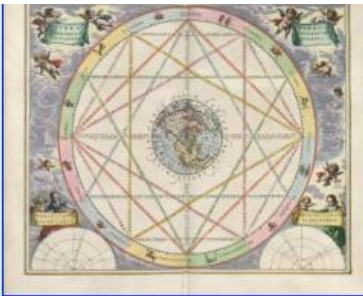


Plate 15

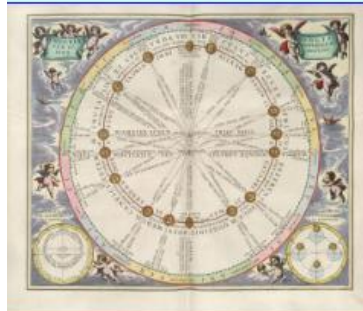


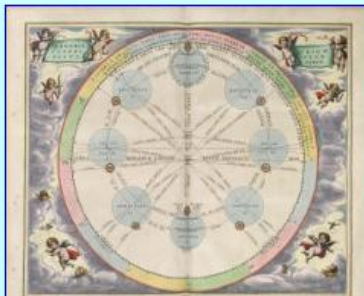
Plate 16



Plate 17



Plate 18

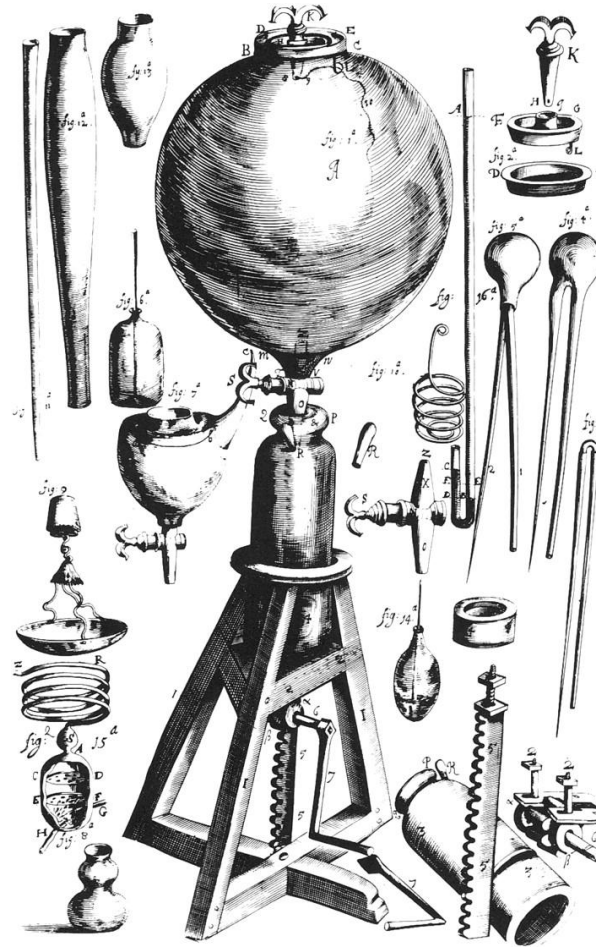


What the Renaissance knew

- Futuristic literature
 - The future: prophets, astrologers, fortune tellers
 - Dante Alighieri: "La Commedia" (1300)
 - Thomas More: "Utopia" (1518)
 - Francis Godwin: "The Man In The Moone" (1638)
 - Athanasius Kircher: "Itinerarium Extaticum" (1656)
 - Cyrano De Bergerac: "Histoire Comique De La Lune" (1656)
 - Cyrano De Bergerac: "Histoire Comique De Le Soleil" (1661)
 - Jacques Guttin: "Epigone - Histoire Du Siecle Future" (1659)
 - Samuel Madden: "Memoirs Of The Twentieth Century" (1733)
 - Louis-Sébastien Mercier: "L'an 2440" (1771)
 - Restif De La Bretonne: "Les Posthumes" (1802)
 - Jean-Baptiste Cousin De Grainville: Le Dernier Homme (1805)

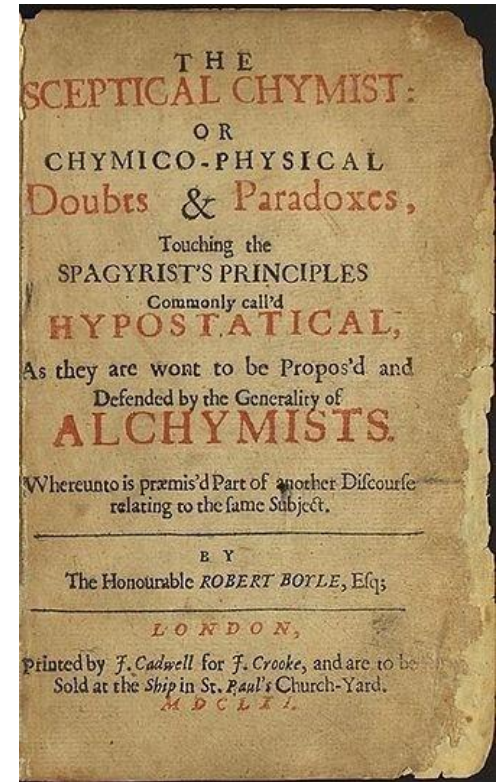
What the Renaissance knew

- Otto Von Guericke (1650) & Boyle (1659)
 - The vacuum



What the Renaissance knew

- Robert Boyle (1661)
 - Founding father of Chemistry as opposed to alchemy
 - Under conditions of constant temperature, the pressure and volume of a gas are inversely proportional (first mathematical law of Physics since Newton)
 - Atomic theory of matter: matter is made of innumerable elementary particles
 - The features of objects are due to the features and motion of the particles they are made of



What the Renaissance knew

- Robert Boyle (1661)
 - God first created atoms and set them in motion so that they created the universe as it is now
 - The properties of a substance are a consequence of its constituents
 - He nonetheless practices alchemy (he even claims to have transformed plants and animals into each other) and defends religion ("The Christian Virtuoso")
 - "New Experiments Physico-Mechanical" (1660): Boyle's Law

What the Renaissance knew

- Theories on the structure of matter in the 17th c
 - Four elements
 - Paracelsus' three principia (salt, sulphur, mercury)
 - Atoms (Gassend, Boyle)

What the Renaissance knew

- Chance Theory
 - Luca Pacioli: “Summa de Aritmetica...” (1494)
 - Girolamo Cardano: “Liber de Ludo Aleae” (1525)
 - Blaise Pascal writes letter to Pierre de Fermat (1654)
 - Christian Huygens: “De Ratiociniis in Ludo Aleae” (1657)
 - Jacob Bernoulli: “Ars Conjectandi” (1689)
 - Abraham de Moivre: “The Doctrine of Chances” (1718)
 - Thomas Bayes’ theorem (1761)

What the Middle Ages knew

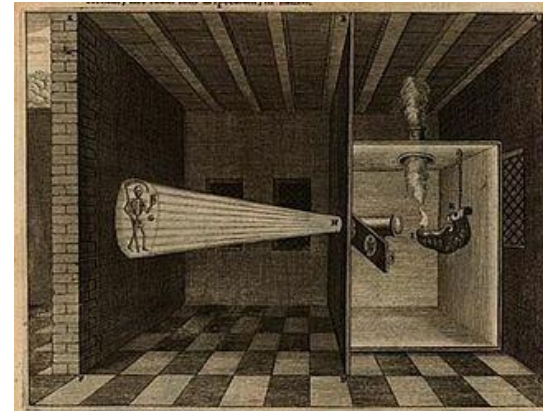
- Magnetism
 - Robert Norman (a compass maker): "The New Attractive" (1581)
 - William Borough (a ship's captain): "Discourse of the Variation of the Compass" (1581)
 - William Gilbert: "On the Magnet and Magnetic Bodies" (1600)
 - First improvement over the medieval theory of Petrus Peregrinus
 - Qualitative (not mathematical) theories
 - Coins the term "electricity" (from "elektron", the Greek name of amber)

What the Middle Ages knew

- Athanasius Kircher (b 1602)
 - "Musurgia Universalis" (1646), a treatise on music
 - "Lingua Aegyptiaca Restituta" (1643) on Egyptian hieroglyphics
 - "China Monumentis" (1667),
 - "Mundus subterraneus" (1665) on volcanos
 - Magnetism and gravity are similar phenomena
 - Evolution of animals
 - The bubonic plague is due to microscopic creatures

What the Middle Ages knew

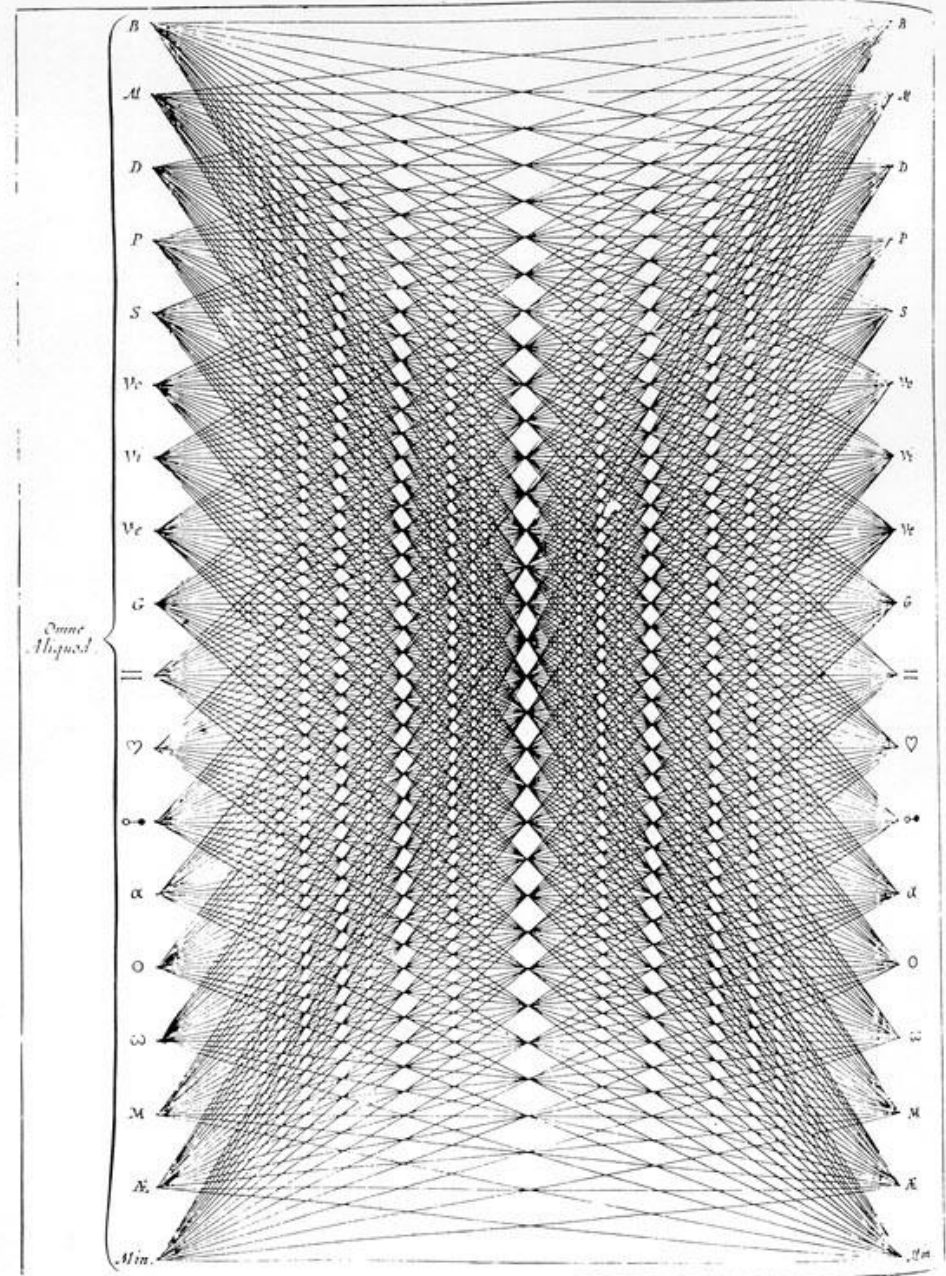
- Athanasius Kircher (b 1602)
 - Inventions: a calculating machine in "Specula Melitensis Encyclica" (1638), the magic lantern in "Ars Magna Lucis Et Umbrae" (1646), a geometric calculator in "Pantometrum Kircherianum" (1669), the megaphone in "Phonurgia Nova" (1673), etc.
 - First public museum (1651)
 - "Ars Magna Sciendi" (1669): symbolic logic



EPILOGISMUS

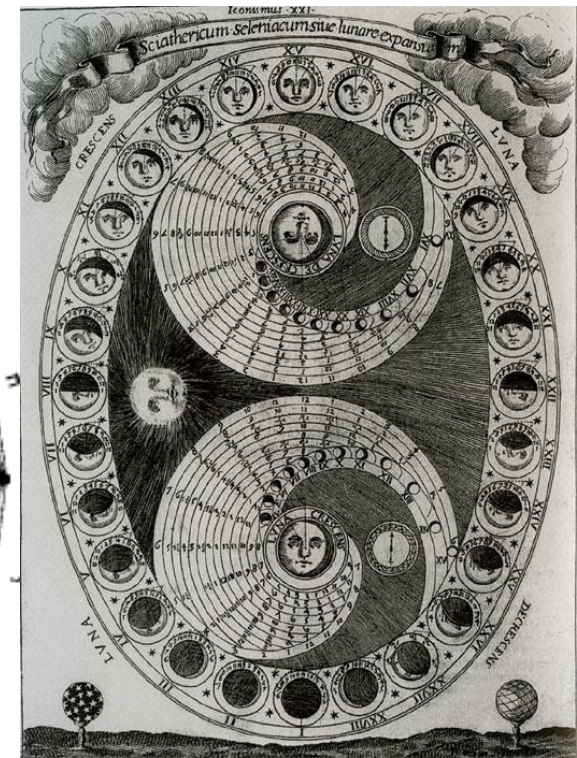
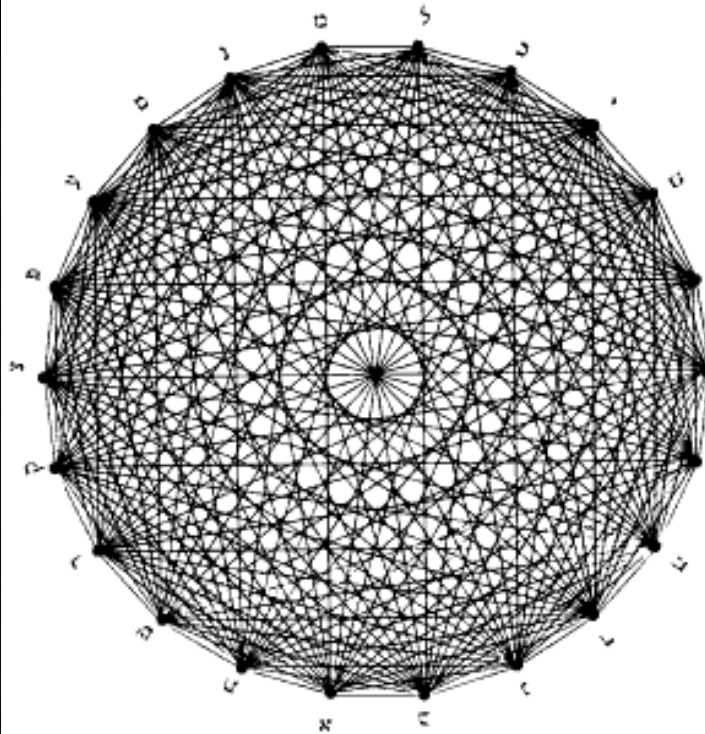
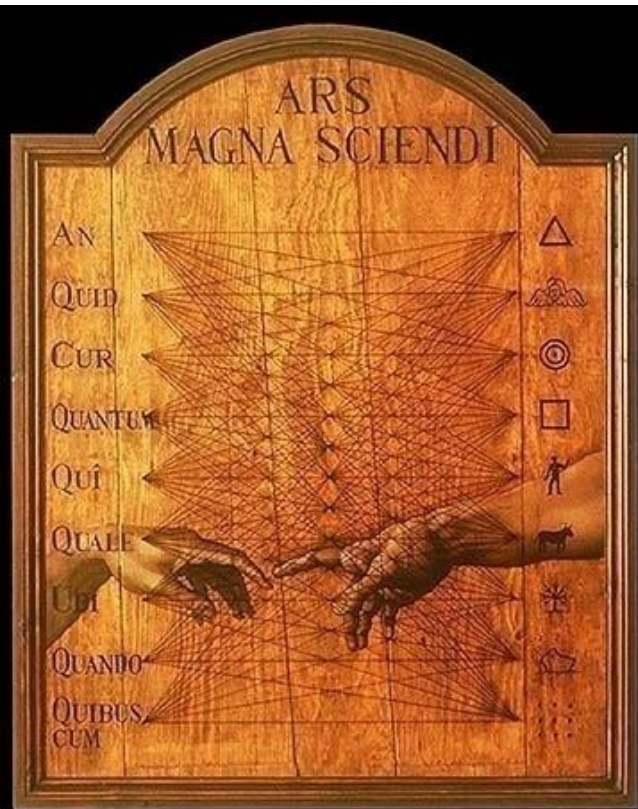
Combinations Linearis.

- Athanasius Kircher



What the Renaissance knew

- Athanasius Kircher's "Ars Magna Sciendi" (1669)
 - Symbolic logic

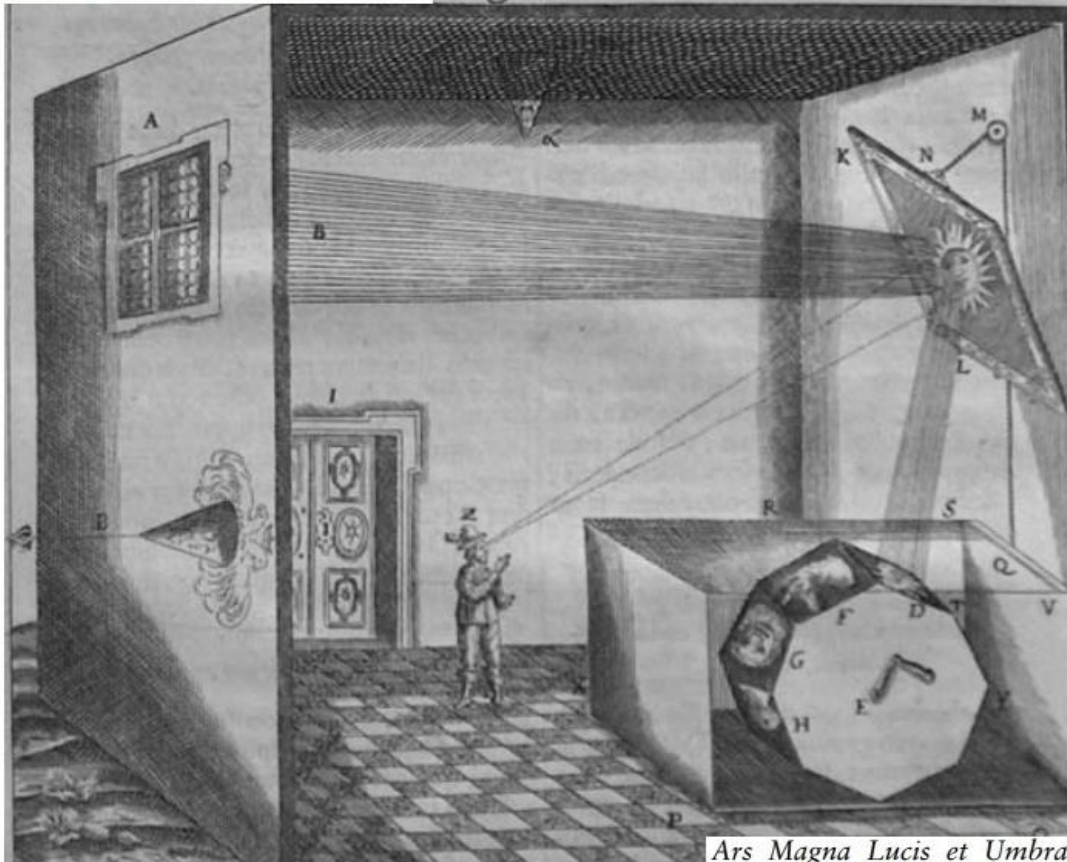


What the Renaissance knew

- Athanasius Kircher's "Ars Magna Lucis"
 - Precursor of the magic lantern

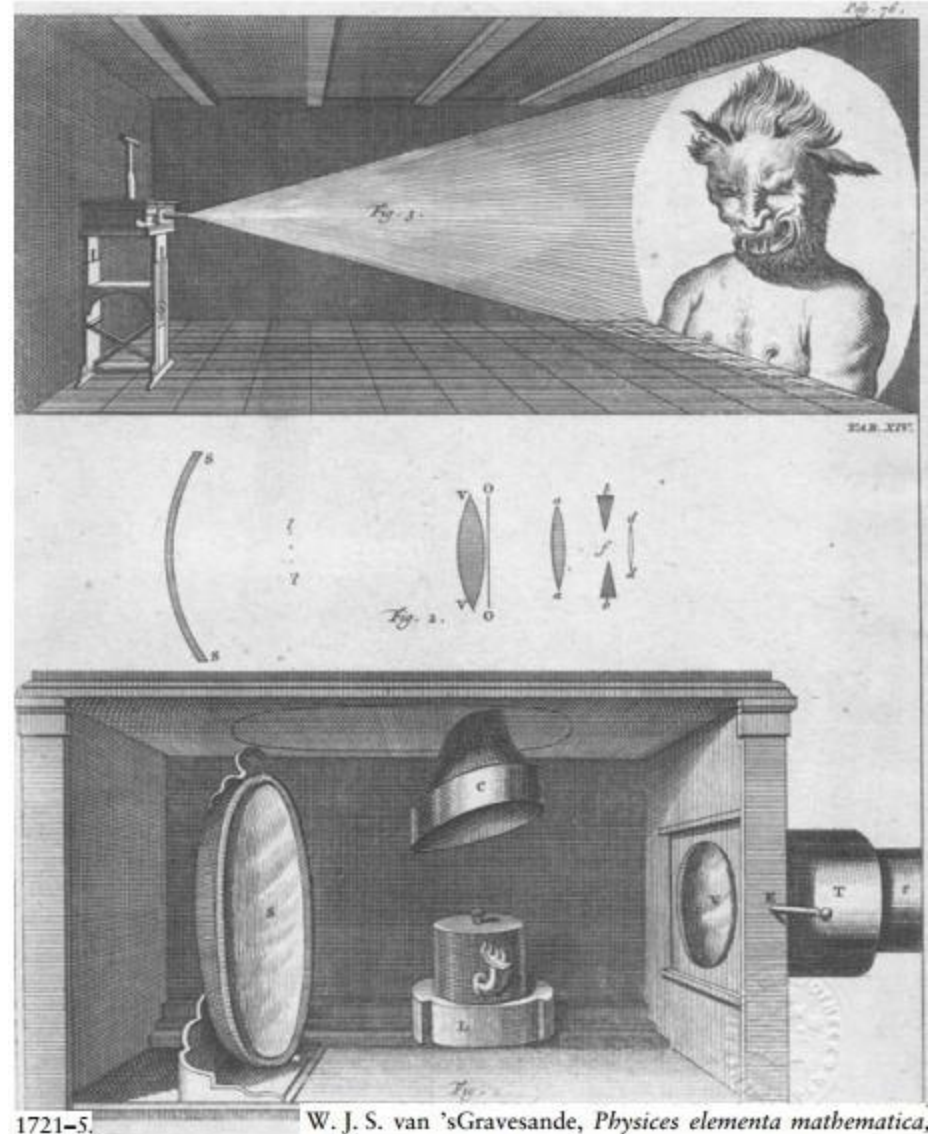
Kircher's metamorphosis machine.

Fig. 4



What the Renaissance knew

- The magic lantern
 - Athanasius Kircher (1645)
 - Christiaan Huygens (1659)
 - Thomas Walgenstein for entertainment (1664, Denmark)
 - Johann Franz Grienel in Nurnberg (1671)
 - Johann Schroepfer for seances (1770s, Germany)
 - Paul Philidor (1786, Germany)
 - Etienne-Gaspard Robertson for phantasmagorias (1802, France)



What the Renaissance knew

- The magic lantern
 - Thomas Walgensten demonstrates the magic lantern in Paris (1664), Lyon (1665), Rome (1665-66), and Copenhagen (1670)
 - After the arrival of instrument maker Johann Franz Grienel in Nürnberg in 1671, the city becomes a major center of magic lantern production

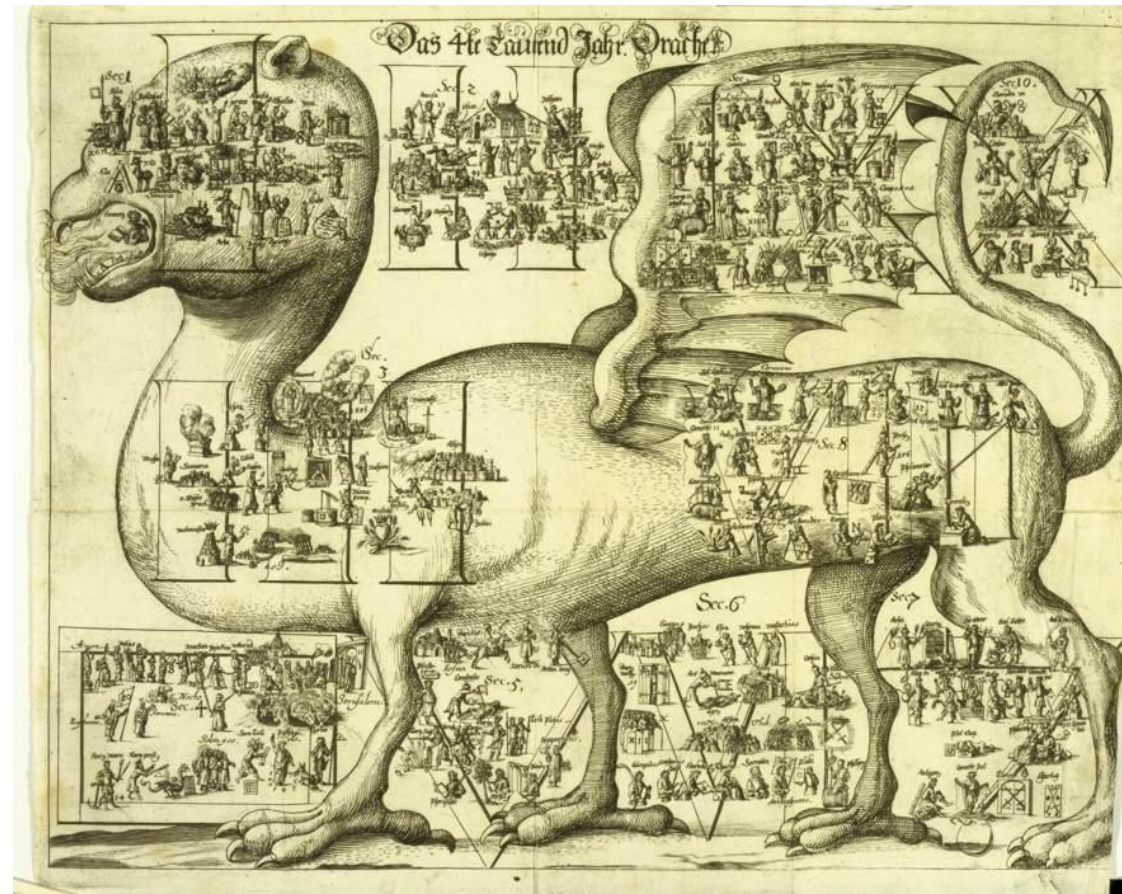
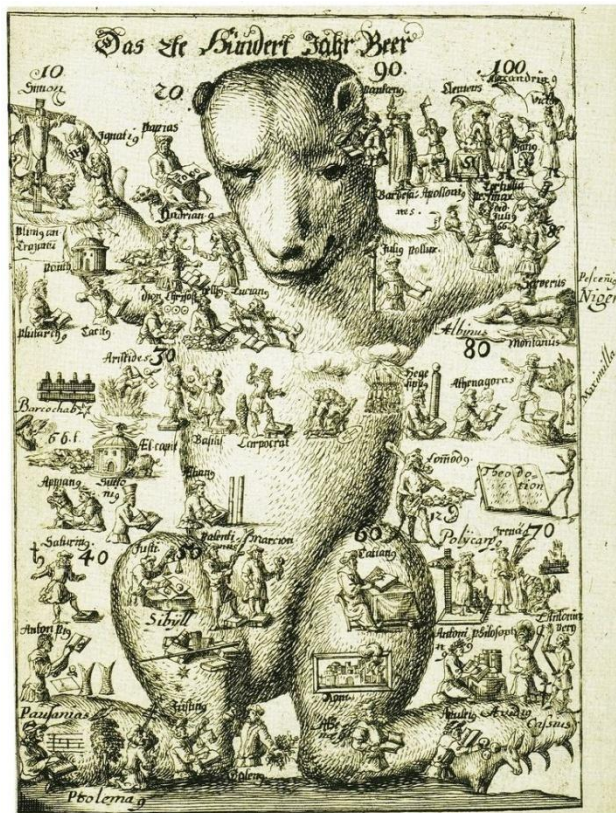
What the Renaissance knew

- Data visualization
 - Johannes Buno's "Historische Bilder, darinnen Idea historiae universalis" (1672)



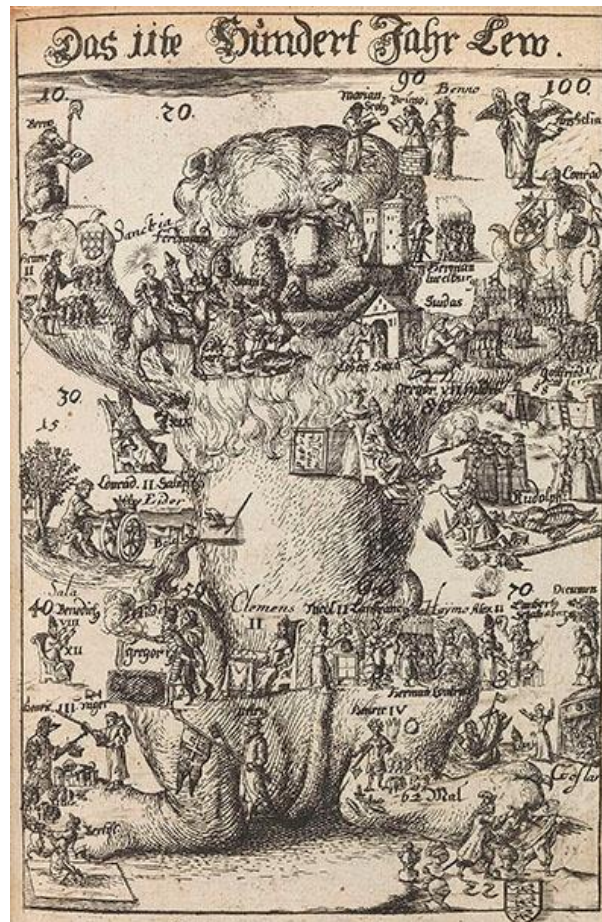
What the Renaissance knew

- Data visualization
 - Johannes Buno's "Historische Bilder, darinnen Idea historiae universalis" (1672)



What the Renaissance knew

- Data visualization
 - Johannes Buno's Bilder



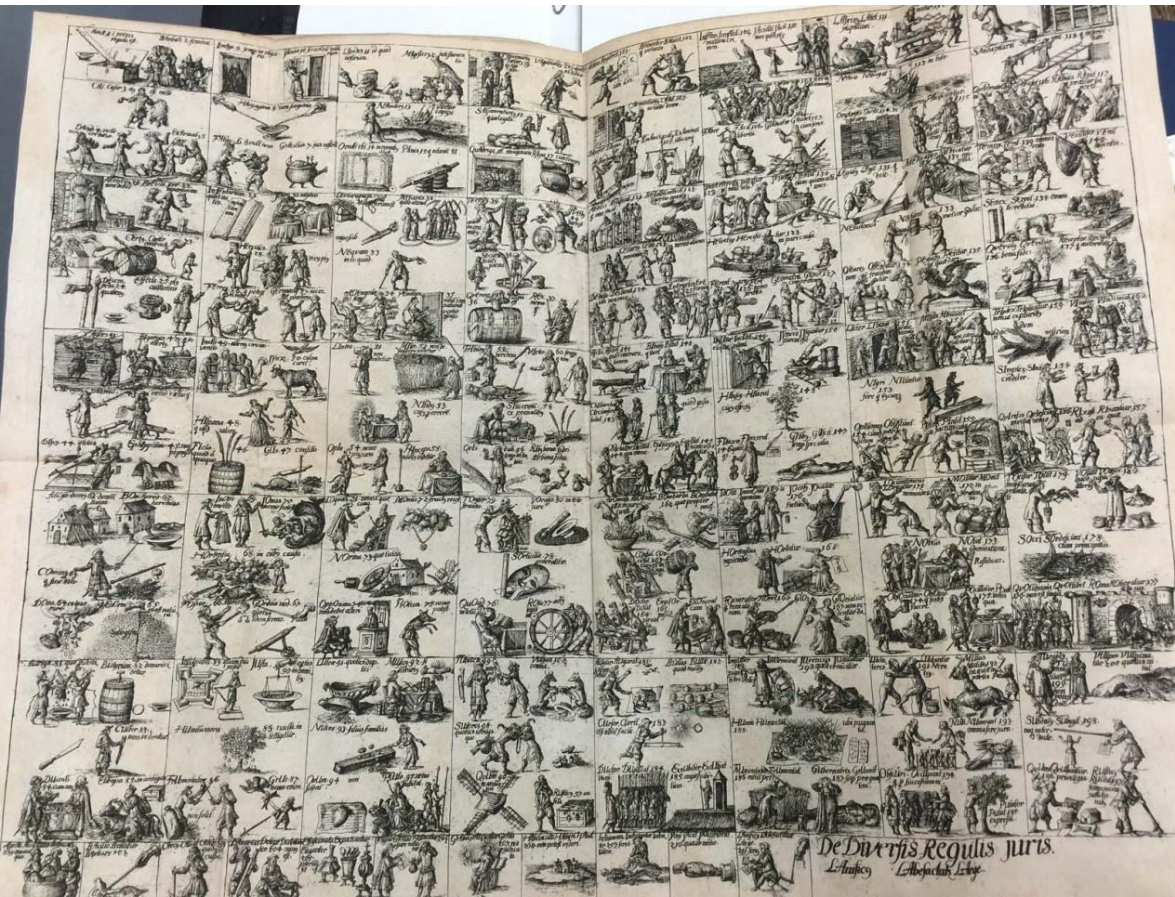
What the Renaissance knew

- Data visualization
 - Johannes Buno's "Historische Bilder"



What the Renaissance knew

- Data visualization
 - Johannes Buno's "Memoriale Institutionum Juris" (1672)



What the Renaissance knew

- Data visualization
 - Johannes Buno's "Bilder-Bibel" (1680)



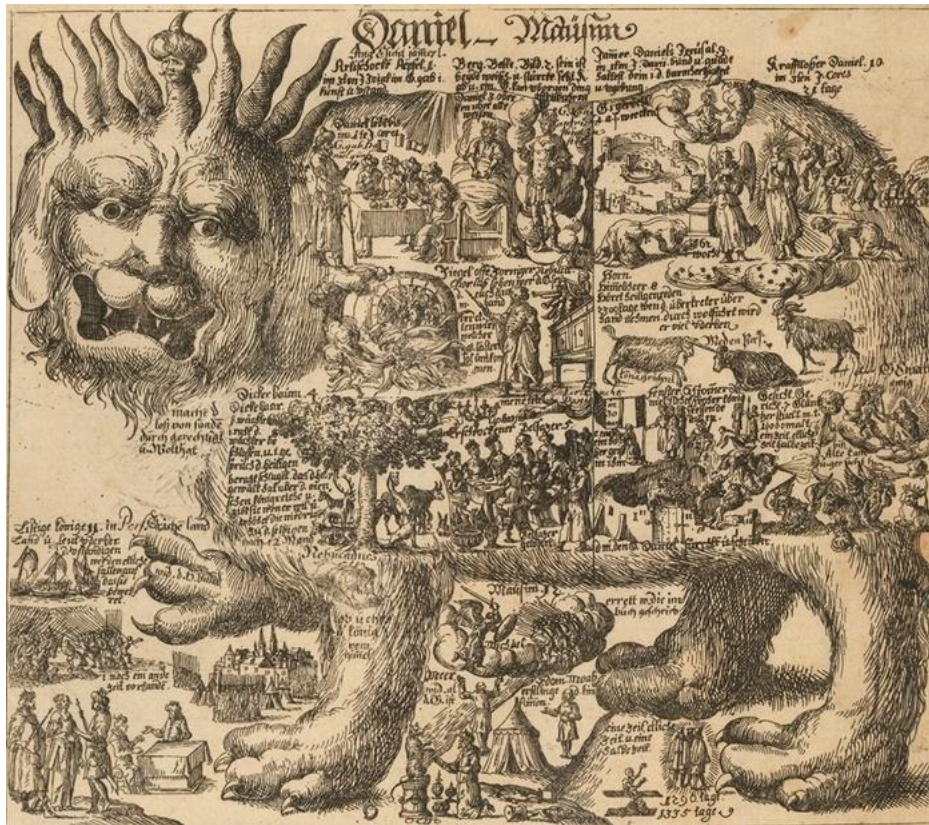
What the Renaissance knew

- Data visualization
 - Johannes Buno's "Bilder-Bibel" (1680)



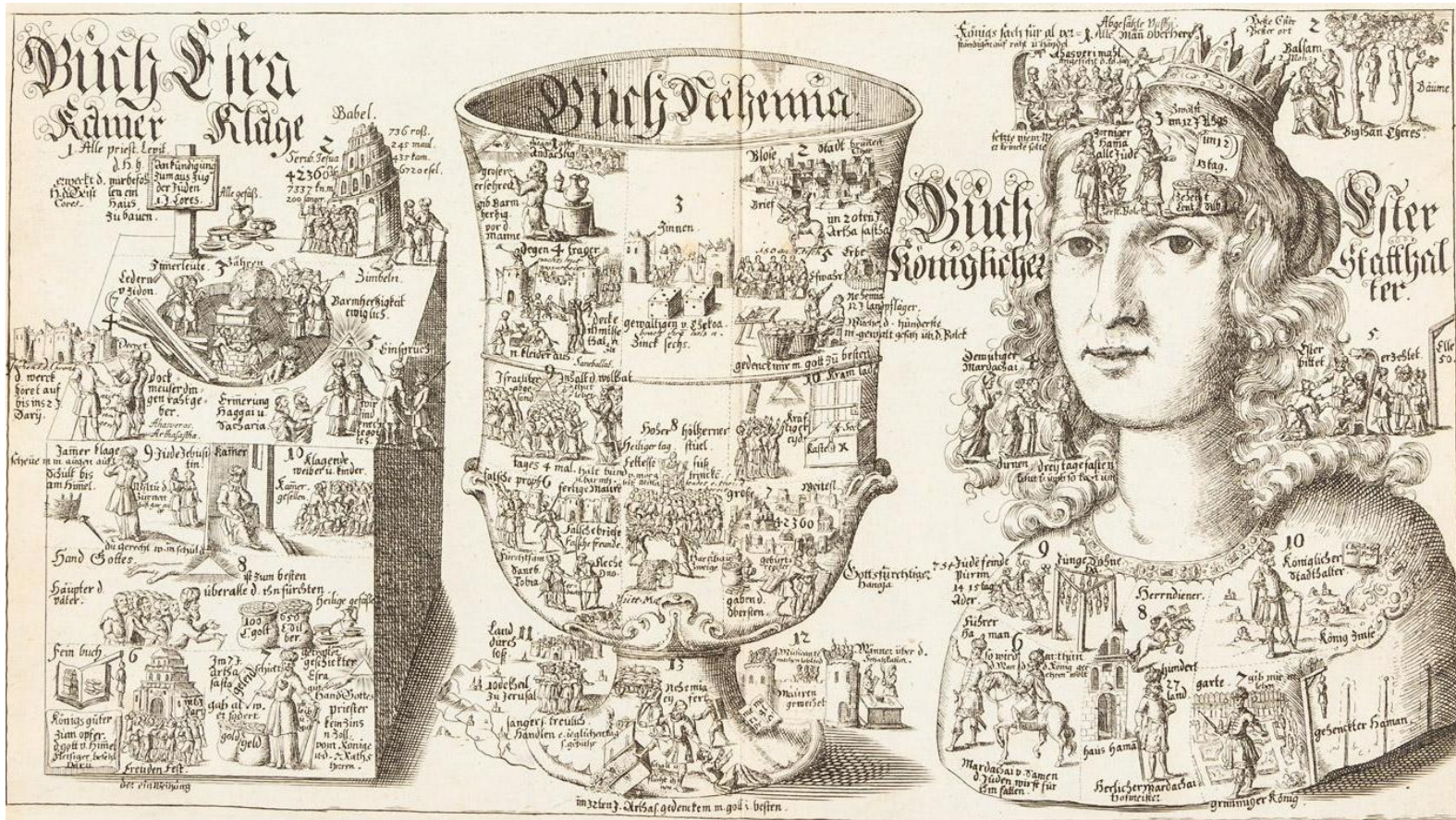
What the Renaissance knew

- Data visualization
 - Johannes Buno's "Bilder-Bibel" (1680)



What the Renaissance knew

- Data visualization
 - Johannes Buno's "Bilder-Bibel" (1680)



What the Renaissance knew

- Francois Poullain de la Barre: “De l’égalité des deux sexes” (1673)

What the Renaissance knew

- Nicolas Malebranche (1675)
 - Objects are limitations of the one material substance
 - Minds are limitations of the one mental substance
 - Minds do not perceive objects, but receive the knowledge about the world of objects from God
 - We have the illusion that our minds cause our body's actions but it is God who creates the sequence

What the Renaissance knew

- Ole Christensen Roemer (1676)
 - Light travels at a finite speed

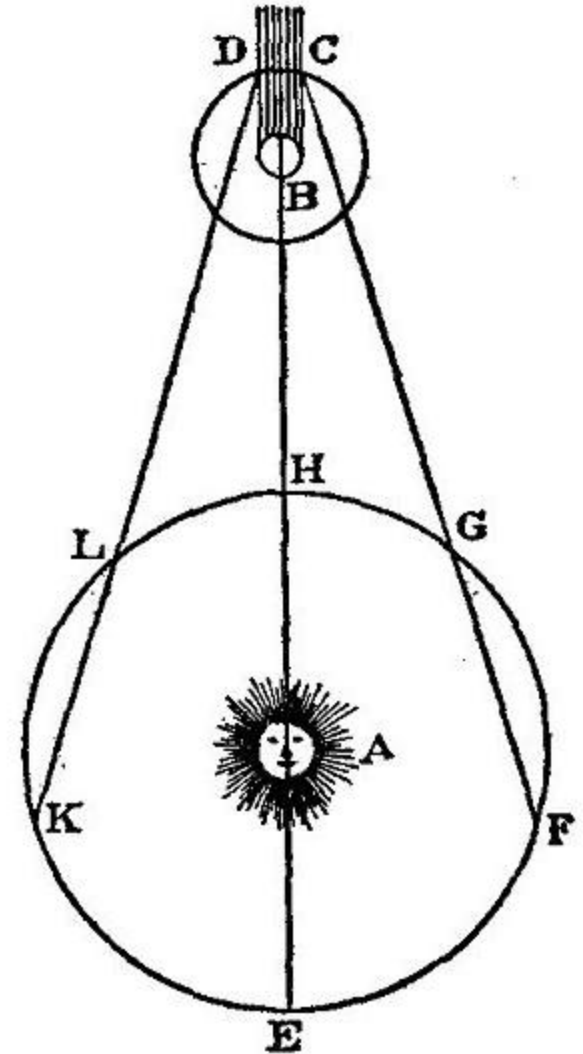


FIG. 70.

What the Renaissance knew



- Baruch Spinoza (1677)
 - Power of reason
 - Separation of faith from philosophy
 - Prophets had no knowledge
 - The Bible is a story of the Jews
 - Miracles are against the nature of God
 - Religion was invented to control societies
 - Humans are just animals
 - Freedoms of thought and speech
 - Precursor of the Enlightenment

What the Renaissance knew



- Baruch Spinoza (1677)
 - God has infinite attributes, two substances cannot share attributes, thus there is only one substance: God
 - Monism instead of dualism: only one substance and it is God/Nature
 - Pantheism: Nature is God
 - God is all that exists (he is what is), there is nothing that is not God (“pantheism”)
 - Spinoza got rid of the mind
 - God/Nature has extension, thought and an infinite number of super-human attributes

What the Renaissance knew



- Baruch Spinoza (1677)
 - Only one substance exists, that is infinite and eternal, and “the” substance has two properties: it is conscious and it has extension.
 - This substance is expressed in an infinite series of “modes”.
 - Humans only perceive two of those modes because we are equipped with only two attributes of that substance, hence we see a world of minds and bodies
 - When we perceive modes through the attribute of *thought*, we perceive *ideas*, and we perceive them through the attribute of *extension*, we perceive *objects*

What the Renaissance knew

- Baruch Spinoza (1677)
 - Things and souls are dependent on other things and souls for their existence, thus they cannot be separate substances
 - Things and souls are (finite) aspects (modes) of that one (infinite) substance
 - Cause, not purpose: we are aware of the purpose of our actions, but not of their causes, so we ascribe our actions to our free will
 - Free will is an illusion
 - Each body is part of a system of interacting bodies: the causes of an action are mostly invisible

What the Renaissance knew

- Baruch Spinoza (1677)
 - God/Nature is both mental and physical ("Deus sive Natura")
 - Every “mode” is also both mental and physical
 - “Mind and body are one and the same individual conceived now under the attribute of thought and now under the attribute of extension”
 - Double-aspect theory: mind and matter are not substances albeit aspects of the same substance
 - The only substance is neither physical nor mental
 - Descartes’ problem is solved because mind and body do not need to interact

What the Renaissance knew

- Baruch Spinoza (1677)
 - Both mind and body strive (conatus) to defend themselves from destructive forces: the body wants to increase its survival through action, the mind wants to increase its understanding through reason
 - As the mind understands more and more, it comes to realize that everything that exists (including the mind itself) “must” be the way it is, because everything is but an aspect of God
 - We are free to understand that we are “modes” of existence of God, but we are not free to change God, therefore we do not have free will
 - Immortality is becoming one with God/Nature, realizing the eternity of everything (“intuition”)

What the Renaissance knew

- Baruch Spinoza (1677)
 - The human mind is the idea of the human body
 - Mind and body are mutually dependent processes that mimick each other
 - A person's actions should not be aimed at pleasing a God, but rather at acting in harmony with Nature
 - Salvation is living in harmony with Nature (love of God)
 - Knowledge and meditation lead to a superior form of salvation: a direct intuition of reality and of the human condition
 - Suffering and death are natural phenomena that we must accept

What the Renaissance knew

- 1681: the Mediterranean and the Atlantic are joined by the Canal du Midi

What the Renaissance knew



- Isaac Newton (1687)
 - The same physical laws apply to the entire universe
 - Every event is controlled by such physical laws
 - Such physical laws can be formulated in terms of mathematical equations
 - All motions in the universe can be treated mathematically
 - Mathematical description of the motion of bodies in space and over time

What the Renaissance knew



- Isaac Newton (1687)
 - Natural state is uniform straight motion
 - Absolute time and space made of ordered instants and points
 - Force as cause of change of motion (acceleration)
 - Conservation of energy

What the Renaissance knew



- Isaac Newton (1687)
 - Galileo: Falling bodies move along parabolas
 - Kepler: Orbiting bodies move along ellipses
 - Newton: gravity explains both Galileo's parabolas and Kepler's ellipses
 - Galileo and Kepler discovered the curves that describe the motion of specific kinds of bodies
 - Newton discovered a method to predict the motion of all bodies, a method to predict the future of the entire universe

What the Renaissance knew

- Isaac Newton (1687)
 - Principle of universal gravitation: every particle of matter in the universe attracts every other particle with a force varying inversely as the square of the distance between them and directly proportional to the product of their masses
 - Gravitational force as cause of planetary motion
 - Action at distance (bodies exert forces on one another through empty space)
 - Unification of terrestrial and celestial mechanics

What the Renaissance knew

- Isaac Newton (1687)

velocity = Distance/Time
Acceleration = Change in Velocity/Time
Force = Mass $\times$ Acceleration
Momentum = Mass $\times$ Velocity
Density = Mass/Volume
Impulse = Force $\times$ Time

Work of energy =
Power = Work/Time
Pressure = Force/Area

Kinitic energy = $\frac{1}{2} mv^2$
Potential energy = Mass $\times$ Acceleration due to gravity $\times$ height

Angular Velocity = Angle/Time
Moment of Inertia = Mass $\times$ (distance)²
Co-efficient of Elasticity = $\frac{\text{Stress}}{\text{Strain}}$

Force $\times$ Distance
Gas Constant = Pressure $\times$ Volume/Temp.
Specific heat = Heat energy/Mass $\times$ Temp.

What the Renaissance knew

- Isaac Newton (1687)
 - Galileo's inertia: the property of a material object to either remain at rest or in a uniform motion in the absence of external forces
 - Newton's inertia: a fundamental quantitative property of matter (mass)
 - What is “mass”? Where does it come from? Why is it related to acceleration?

What the Renaissance knew

- Isaac Newton (1687)
 - The “impetus” of medieval scholastics is replaced by the “momentum” (that accounts for the continued movement of bodies)
 - Gravity holds the universe together

What the Renaissance knew

- Isaac Newton (1687)
 - The motion of falling bodies, the motion of projectiles, of the Moon around the Earth, of the planets around the Sun are all caused by the same force and explained by one universal law
 - But it requires faith in a force that operates at distance, across empty space, without an intermediary (Huygens refused to believe it)

What the Renaissance knew

- Isaac Newton (1687)
 - Light is made of atoms (it moves in straight lines)
 - Light does not travel from the observer's eye to the object but from the object to the eye

What the Renaissance knew

- Newton (1687)
 - Old view of the world
 - The universe is static. Stars have been placed by God in their place and will always occupy that location.
 - There is a fundamental difference between the Human world of the Earth and the Divine world of the Heavens
 - Galileo peaked into the Heavens and didn't find the Divine but more Earths and Moons

What the Renaissance knew

- Newton (1687)
 - New view of the world
 - Mathematics and Mechanics can explain Nature
 - Earth and Heavens obey the same laws
 - Matter is made of atoms subject to mechanical laws: *“The smallest particle of matter may cohere by the strongest attractions, and compose bigger particles of weaker virtue. And many of those may cohere, and compose bigger particles whose virtue is still weaker. And so on for diverse successions until the progression ends in the biggest particles on which the operation in chemistry and the colors of natural bodies depend.”*

What the Renaissance knew

- Newton (1687)
 - Breakdown of the medieval synthesis of the natural and the supernatural
 - The same physical laws apply to the Earthly and Heavenly realms
 - Determinism: the world is a machine

What the Renaissance knew

- Newton (1687)
 - Time used to be a subjective experience
 - Newton's time is outside consciousness
 - Newton's time exists and flows regardless of who experiences it
 - Newton's time is the same for everybody

What the Renaissance knew

- Newton (1687)
 - Newton's equations are symmetrical in time
 - And still time flows only in one direction
 - Time is infinitely divisible, made of infinitesimally small instants

What the Renaissance knew

- Newton (1687)
 - Inductive principle (perhaps even more important than his laws of motion): If something is true of what we've seen around here, it must be true everywhere in the universe.

What the Renaissance knew

- Newton (1687)
 - Birth of the Enlightenment
 - Birth of the industrial revolution
 - Science applied to everything: society (Comte), economy (Smith), politics (Marx), psyche (Freud)

What the Renaissance knew

- Isaac Newton
 - God's role: God is necessary to keep gravitation from destroying the universe
 - Newton furious at Locke for the immoral and athetistic implications of "Essay Concerning Human Understanding"
 - Newton's occult, alchemical and Biblical studies ("Newton was not the first of the age of reason, he was the last of the magicians" – Keynes)

What the Renaissance knew

- Newton (1687)
 - Unwanted implications
 - The universe cannot possibly be static (stars should collapse into each other because of gravitational attraction)
 - Olbers' paradox (an infinite number of stars makes night impossible)
 - Newton is reluctant to admit change and does not see evolution at all
 - Newton defends the Bible

What the Renaissance knew

- Newton (1687)
 - Galileo published in Italian, Descartes in French but Newton in Latin

What the Renaissance knew



- John Locke (1690)
 - Boyle's world:
 - Matter is composed of elementary particles
 - The features of objects are due to the features and motion of the particles they are made of
 - Objects are machines
 - The world as a whole is a giant machine

What the Renaissance knew



- John Locke (1690)
 - Ideas as the elementary particles of mind
 - All bodies possess "primary" qualities (solidity, extension, figure, number, and motion): qualities which are "inseparable" from the bodies themselves
 - Secondary qualities are the ones that produce sensations in observers (color, sound, taste)
 - Secondary qualities can be understood in terms of the primary qualities that produce them

What the Renaissance knew

- John Locke (1690)
 - Perceptions are mechanical interactions with objects, that cause mechanical interactions within the nervous system and ultimately the brain, where “sensations” arise (“causal” theory of perception)
 - These sensations produce ideas in our minds
 - Simple ideas are then combined by Reason to become complex ideas
 - All knowledge derives from experience (“empiricism”)
 - Knowledge is acquired, not innate

What the Renaissance knew

- John Locke (1690)
 - The sensations are caused by the objects, but all we know is the sensations, not necessarily the real objects
 - The world is not necessarily what appears to us
 - Our theories of the world are only hypotheses, based on sensations that may not represent the truth and based on experiences that represent only a fraction of the “experienceable” world
 - Human knowledge is limited

What the Renaissance knew

- John Locke (1690)
 - Ideas rule our mind
 - The mind “hath no other immediate object but its own ideas”
 - Ideas derive from experience, although some ideas may derive from other ideas
 - The mind is helpless against simple ideas due to sense-experience
 - The mind can combine, relate and abstract ideas to form other ideas
 - The mind is an integrator of sensations caused by the interaction with the external world

What the Renaissance knew

- John Locke (1690)
 - Birth of psychology: Locke replaces “soul” with “mind”
 - The soul exists (forever), but it is separate from the mind (a natural object, based on matter, thinking matter)
 - 1694 edition: “consciousness”
 - The self, created by consciousness, grows and changes just like the body
 - The “I” is created by experience
 - Morality is not innate but needs to be taught

What the Renaissance knew

- John Locke (1690)
 - Hobbes-ian social contract, but the ruler does not have absolute power and can be removed by the people
 - People have rights (condemn of absolutism)
 - Universal rights of life, liberty and property
 - Government has the duty to protect their rights and first and foremost their property rights
 - Three branches of government for "checks and balances"
 - Separation of church and state
 - Rule of the majority ("liberalism")

What the Renaissance knew

- John Locke (1690)
 - Note: Locke believes in miracles and Bible's revelation

What the Renaissance knew

- John Locke's influence
 - Boom of pedagogy: a child is a "blank slate" ("tabula rasa") to be molded by education
 - Boom of autobiography (Margaret Cavendish, Samuel Pepys, DeFoe's fictional autobiography)
 - Boom of moral relativism (Newton accuses Locke of immorality and atheism)
 - Boom of pamphlets after 1694 when the Licensing Act expires

What the Renaissance knew

- John Locke's influence
 - French (and Latin) are the universal languages of academia, not English
 - But Pierre Coste translates Locke into French
 - Huguenots expelled from France after 1685 establish French-language publications abroad
 - Pierre Bayle's "Nouvelles de la republique des lettres » (1684)
 - Jean LeClerc's "Bibliothèque universelle et historique" (1686)
 - Jacques Bernard's "Histoire abregée de l'Europe" (1686)

What the Renaissance knew

- John Locke's influence
 - Voltaire's "Philosophical Letters" (1734) describe the free scientific, philosophical, religious and political life of England, and publicizes Bacon, Newton and Locke to the French-speaking world
 - Voltaire's lover Emilie du Chatelet translates Newton's "Principia"

What the Renaissance knew

- Secular Ethics in Britain
 - William Coward (1702): the soul dies with the body
 - Ashley Cooper Shaftesbury (1711): innate moral sense, universal sense of what is good
 - Bernard Mandeville (1711): there is no innate moral sense
 - Francis Hutcheson (1725): Locke's thinking matter + Shaftesbury's innate moral sense + minds interact with a shared compassion ("sympathy") among people

What the Renaissance knew

- Secular Ethics in Britain
 - David Hartley (1749)
 - Locke's theory of mind + Newton's physics + Christianity
 - Associative nets of vibrations in the brain, caused by sensations, result in actions (problem: where's free will?)
 - Humankind destined to ever greater perfection until it will merge with Jesus' perfection
 - Pioneer of psychology

What the Renaissance knew

- Madness in England
 - The new Bethlehem Hospital or “Bedlam” (1675) allows visitors to stare at the insane
 - Note: people who claim to be prophets are likely to end up in Bedlam, not worshipped
 - Westminster General Infirmary (1719)
 - Wing for the insane at Guy’s Hospital (1725)
 - St Luke’s Hospital for Lunatics (1751)

What the Renaissance knew

- Madness in England
 - William Battie: “A Treatise on Madness” (1758), a scientific study of madness based on Locke’s materialist theory of mind
 - Andrew Harper: “A Treatise on the Real Cause and Cure of Insanity” (1789)
 - 1789: Francis Willis cures King George III’s madness using Battie’s methods
 - Mental health is not theology but medicine

What the Renaissance knew

- Mechanistic Medicine
 - Hermann Boerhaave in Leiden
 - Albrecht von Haller in Goettingen: irritability and sensibility
 - Giovanni Borelli in Rome
 - Friedrich Hoffmann in Halle
 - Most doctors reject Locke's materialist theory of the mind but accept Descartes' dualism
 - Robert Whytt in Edinburgh discovers the sympathetic nervous system

What the Renaissance knew

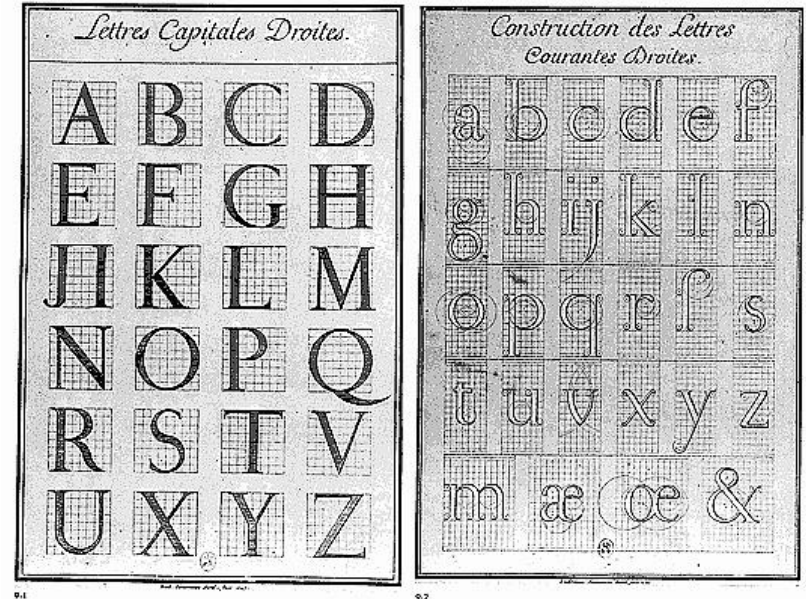
- Anti-Locke medicine
 - George Cheyne: “The English Malady” (1734), a bestseller (immorality causes mental diseases)
 - Georg Stahl (Halle): “Theoria medica vera” (1708), founder of animism (the soul controls all bodily functions)
 - Francois de Sauvages (Montpellier, 1731): between animism and vitalism

What the Renaissance knew

- The printing press in Britain
 - 1621: Thomas Archer publishes the first periodical pamphlet (predecessor of the newspaper)
 - 1695: the "Liberty of Unlicensed Printing" removes government control from the press (freedom of the press)
 - 1709: the Copyright Act shifts ownership from printers to authors

What the Renaissance knew

- The printing press in France
 - 1692: Louis XIV of France commissions a new “scientific” font



What the Renaissance knew

- Anatomy
 - Scientific study of the human body



What the Renaissance knew

- Anatomy
 - Tobias Cohn's "Ma'aseh Tobiiyyah/ Work of Tobias" (1707, Poland)



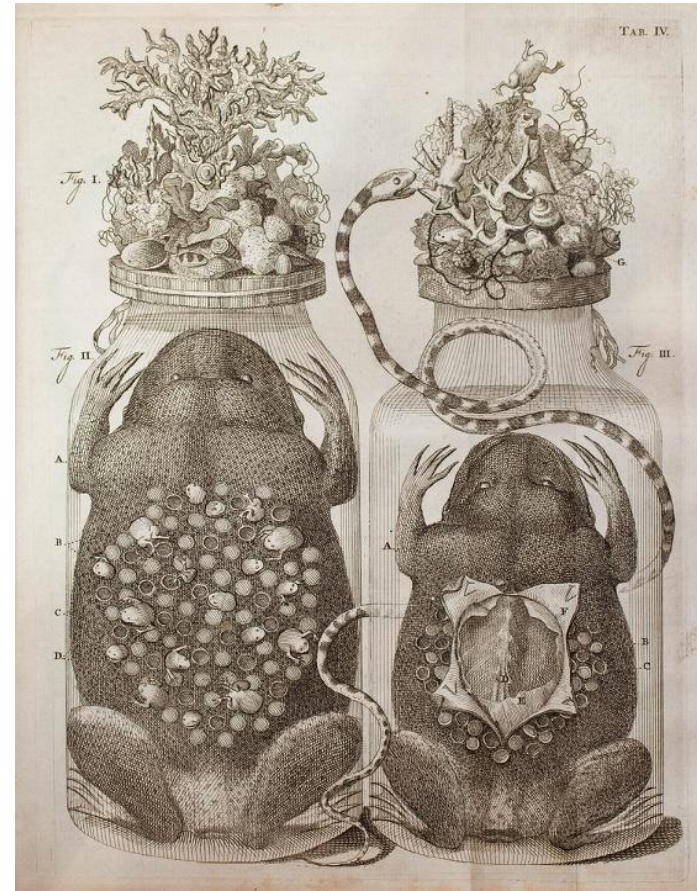
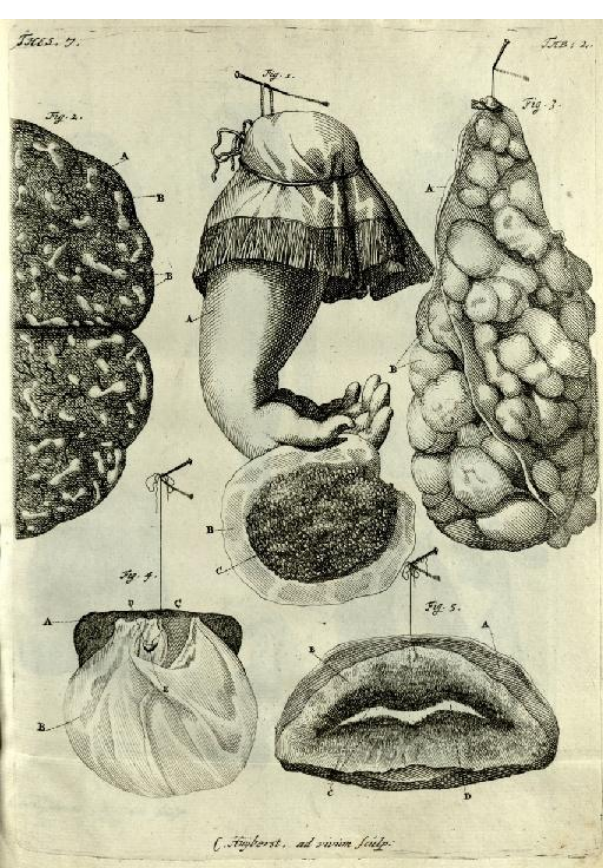
"The House of the Body", an allegorical drawing that explains the organs of the body as rooms in a house

What the Renaissance knew

- Anatomy
 - Frederik Ruysch's "Thesaurus anatomicus" (1701–1716, Holland)
 - Secret embalming technique
 - Europe's most famous anatomical collections (a scientific version of the cabinet of curiosity)
 - Baroque drawings of gruesome anatomy
 - 1717: The entire collection as well as the secret formula for the liquor balsamicus is purchased by czar Peter the Great

What the Renaissance knew

- Anatomy
 - Frederik Ruysch's "Thesaurus anatomicus" (1701–1716, Holland)



What the Renaissance knew

- Anatomy
 - Frederik Ruysch's influence on the arts
 - Giacomo Leopardi: "Dialogue Between Frederik Ruysch and His Mummies" (1827)
 - Honoré de Balzac's novel "The Wild Ass's Skin" (1831)
 - Olga Tokarczuk's novel "Flights" (2018)
 - Jan van Neck: "The Anatomy Lesson of Dr Frederick Ruysch" (1683)



What the Renaissance knew

- Traditional view of female anatomy:
 - There is a one-to-one correspondence between male sexual organs and female sexual organs
 - Female genitals are mirror images of male genitals, eg the vagina is an inner penis (basically, there is only one sex, and women are inverted men)
 - Both men and women enjoy sex equally
 - Ovidius (1st c AD): Tiresias (who has been both a man and a woman) testifies to Jupiter that women enjoy sex more than men (Juno blinds him and he becomes the greatest of fortune tellers)

What the Renaissance knew

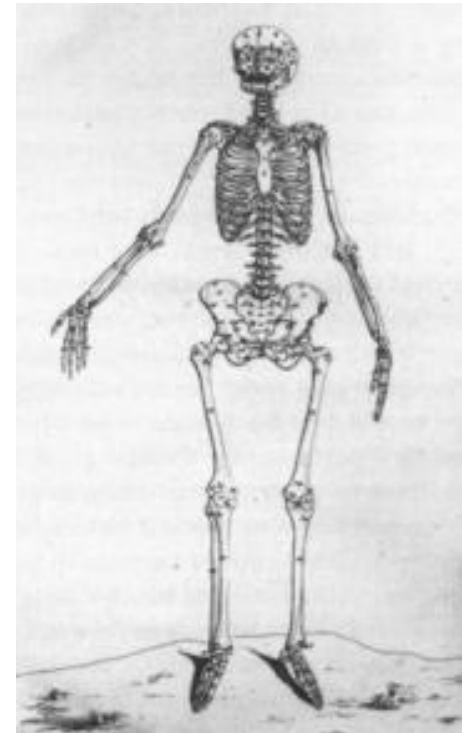
- Traditional view of female anatomy:
 - Male and female orgasms are both required to have conception
 - Male and female fluids produced during orgasm mix to create a new being
 - Women should have sex in the middle of the menstrual cycle whenever they want to minimize chances of getting pregnant

What the Renaissance knew

- Renaissance view of female anatomy:
 - Renaldus Columbus "De Re Anatomica" (1559)
"discovers" the clitoris, which alters the male-female symmetry (the vagina is no longer the only organ corresponding to the penis)
 - William Harvey (1651): all life originates from an egg
 - Anton van Leuwenhoek (1677): male sperm contains many tiny organisms
 - Sexual reproduction is widespread in nature

What the Renaissance knew

- Enlightenment's view of female anatomy:
 - Marie-Geneviève-Charlotte Darlus (1759): first detailed female skeleton in an anatomy book
 - Pierre Roussel (1775): “The Physical and Moral System of the Woman”
 - Theodor von Bischoff (1843) and Adam Raciborski (1844): Ovulation occurs spontaneously, i.e. woman is a “spontaneous ovulator”
 - Georg-Ludwig Kobelt (1844): “Die männlichen und weiblichen Wollust-Organen des Menschen und einiger Säugetiere/ The Male and Female Organs of Sexual Arousal in Man and some other Mammals”



What the Renaissance knew

- Enlightenment's view of female anatomy:
 - Conception is due to the union of male sperm and female egg
 - Oskar Hertwig (1876): the male sperm penetrates the female egg and the union of their nuclei constitutes fertilization
 - Sexual pleasure induces women to have sex even if it is dangerous to their survival
 - The two sexes are different

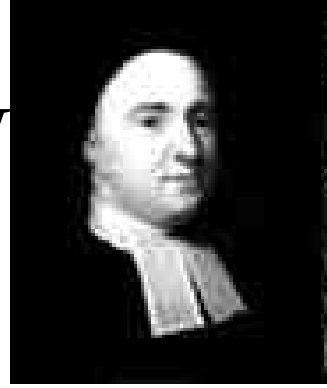
What the Renaissance knew

- Religious skeptics
 - Herbert of Cherbury: "On Truth" (1624) attacks religious revelations
 - Richard Simon: "Critical History of the Old Testament" (1680) attacks the Bible as mythology
 - Pierre Bayle: "Critical and Historical Dictionary" (1697) attacks Christian superstitions
 - Pierre-Daniel Huet: "Traite' philosophique de la foiblesse de l'esprit humain" (1721)

What the Renaissance knew

- Pietism
 - Philip Spener: "Reform of the True Evangelical Church" (1675)
 - George Fox: the Quakers (1652)
 - John Wesley: Methodists (1729)

What the Renaissance knew



- George Berkeley (1710)
 - Idealism
 - Critique of Newtonian world: matter does not even exist
 - All we know is our perceptions
 - We cannot directly know that there is an external world ("esse est percipi")
 - Reality is inside our mind: an object is an experience
 - The whole universe is a set of experiences
 - The only thing that exists is the experiences of our mind
 - The only thing that exists is mind
 - The world is exactly how it appears: it "is" what appears, and it is inside our mind
 - Our mind rules ideas

What the Renaissance knew

- George Berkeley (1710)
 - Reality consists of finite, created minds; an infinite, uncreated mind; ideas
 - Objects do not exist apart from a subject that thinks them.

What the Renaissance knew

- George Berkeley (1710)
 - An object ceases to exist if no mind perceives it
 - Nature is God's sensium, the set of all the things that God perceives
 - All things exist in God, eternal and total perceiver, but their "relative existence" begins when they are perceived by minds

What the Renaissance knew

- **George Berkeley (1710)**
 - Motion of a body can only be relative to another body

What the Renaissance knew



- **Gottfried Leibniz (1714)**
 - **Panpsychism**
 - **Only minds exist**
 - **There are infinite minds**
 - **Humans are not the only ones to have minds**
 - **Everything has a mind**
 - **Matter is made of minds (Leibniz got rid of the body!)**
 - **Minds come in degrees, starting with matter (whose minds are very simple) and ending with God (whose mind is infinite)**
 - **Reality is the set of all finite minds (or "monads") that God has created**

What the Renaissance knew



- **Leibniz (1714)**
 - A monad is capable of perceiving other monads and of changing its state of knowledge
 - Thought is just a kind of “perceiving”.
 - Some perceptions are “unconscious” (inert matter only has unconscious perceptions)
 - When knowledge (awareness) increases, we feel pleasure. When knowledge decreases, we feel pain.
 - All monads want to increase their knowledge
 - We are born with the concepts of God and Mathematics

What the Renaissance knew



- Leibniz (1714)
 - Monads have free will but their actions have been determined by God
 - There is no cause-effect relationship between events: God has pre-determined the harmony of the universe. Monads cannot influence each other. Monads are “clocks that strike hours together”.
 - Mind and body do not communicate: they too have been synchronized by God
 - God also decided what free will a nomad has

What the Renaissance knew



- Leibniz (1714)
 - Space is an illusion: we perceive as “close” what we “know” better (are aware of)
 - Instead of space and time, there are two series: the series of all monads, ordered by degree of activity, and the successive states of a monad
 - Space and time are divided into monads (not point and instant)
 - Two monads with the same properties in the same “place” are the same monad, because properties of a monad “are” function of its place

What the Renaissance knew



- Leibniz (1714)
 - "Lingua characteristica": universal language based on the laws of Logic
 - The true statements of this world form a coherent system
 - By applying combinatorial rules, we can derive all possible knowledge
 - This system also provides for a universal language of communication

What the Renaissance knew



- Leibniz (1714)
 - "Lingua characteristica": universal language based on the laws of Logic
 - The disparate disciplines of human knowledge can be unified by translating them into a universal language: a small set of primitive signs and a set of combinatorial rules to operate on them
 - The answer to any question can be obtained by a mechanical procedure of applying the rules to the signs

What the Renaissance knew

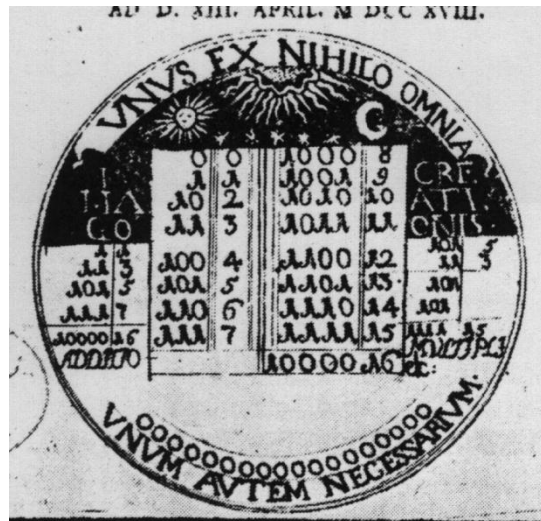


- **Leibniz (1714)**
 - **Many possibly worlds: ideas in the mind of God (we live in the best of possible worlds)**
 - **Evil exists so that we can appreciate goodness**

What the Renaissance knew



- Leibniz (1703)
 - Binary arithmetic
 - “... the origin of the numbers from 0 and 1, which I have observed is the most beautiful symbol of the continuous creation of things from nothing, and of their dependence on God”



What the Renaissance knew

- Bernard Mandeville (1714)
 - Cynical view of the free market and capitalism
 - Private vices yield public virtue
 - Vice is a necessary condition for economic prosperity
 - Unbridled vicious passions of humans (such as greed) result in invisible cooperation
 - The luxuries condemned by moralists are precisely what makes the community prosperous (what “sells”)
 - Selfish private greed creates an economy that ends up benefiting the whole community

What the Renaissance knew

- New Mathematics
 - Arabic numbers (16th century)
 - Signs for addition, subtraction, multiplication: Francois Vieta (1603)
 - Logarithms: John Napier
 - Analytical Geometry: Renee Descartes (1637)
 - Calculus: Newton and Leibnitz (1660s)

What the Renaissance knew

- Calculus
 - Descartes: analytic geometry
 - Leibniz (1675)
 - Newton (1666)
 - Function $\lim_{x \rightarrow x_0} f(x) = l$
 - Limit
 - Derivative
 - Integral

What the Renaissance knew

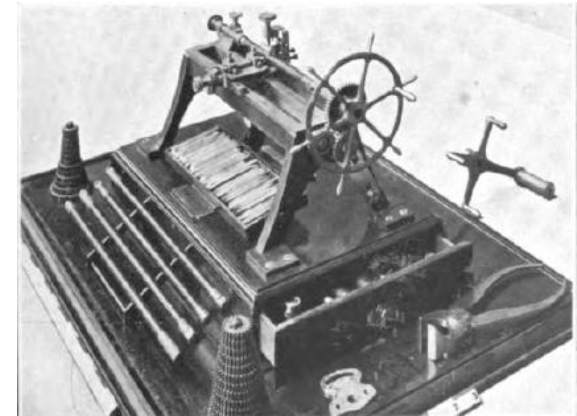
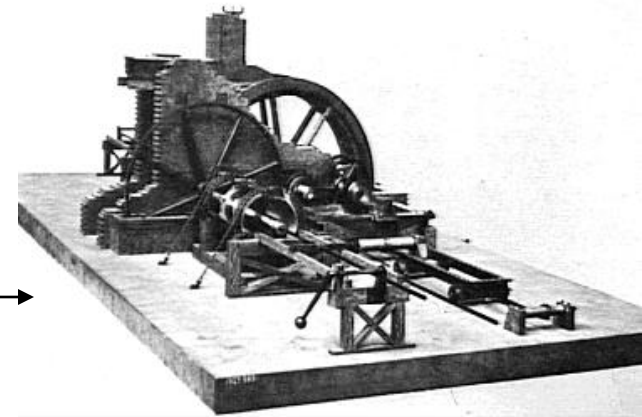
- New Inventions
 - Telescope (1608, Dutch)
 - Microscope (1590s, Dutch)
 - Pendulum clock (1657, Dutch)
 - Barometer (1644, Italian)
 - Thermometer (1611)

What the Renaissance knew

- Prelude to industrialization
 - 1709: Abraham Darby pioneers the use of coke instead of coal to fuel the blast furnace
 - 1712: Thomas Newcomen invents the steam engine to pump water from a coal mine

What the Renaissance knew

- Prelude to industrialization
 - Metal revolution of the late 18th century
 - Most machinery still made of wood until 1800
 - Abraham Darby's iron foundry (1708)
 - John Wilkinson's boring machine (1774) that makes Watt's steam engine practical →
 - Henry Maudslay's all-metal lathe (1794), a precision machine for screw cutting →
 - Metalworking mostly confined to England



What the Renaissance knew

- Prelude to industrialization
 - Iron industrial machinery enables
 - Large quantity production
 - The system of interchangeable parts
 - The lead in iron industrial machinery moves to the USA, eg Eli Whitney's mill (1800, Connecticut)
 - Original metal products: firearms and clocks
 - Enabled inventions: sewing machine and harvesting machines

What the Renaissance knew

- The Needham Question
 - Why was China overtaken by the West in science and technology, despite its earlier discoveries and inventions?
 - In 1725 the Qing Dynasty government has to make 250,000 bronze movable type characters to print 64 sets of the encyclopedic “Gujin Tushu Jicheng/ Complete Collection of Illustrations and Writings from the Earliest to Current Times”

What the Renaissance knew

- Christian Wolff (1732)
 - Leibniz
 - Empirical psychology
 - Consciousness is the soul

What the Renaissance knew

- Carl “Linnaeus” von Linne (1735)
 - Three kingdoms: minerals, plants and animals
 - Species: defined by reproduction/ interbreeding
 - Classes, orders, genera and species
 - Humans constitute one of the animal species, “Homo Sapiens”, that belongs to the order of primates (first classification of humans with animals)
 - Species have not always been the same

What the Renaissance knew

- Carl “Linnaeus” von Linne (1749)
 - Species form a collective unit, each one playing a role in the overall scheme of things (ecosystem)
 - Species are adapted to a geographical region
 - Species were all born in a primeval island and then migrated

What the Renaissance knew

- Carl “Linnaeus” von Linne (1751)
 - Creationism: God created in one location single pairs of animals, which then multiplied and migrated to their eventual homes

What the Renaissance knew

- Daniel Bernoulli (1738)
 - Macroscopic properties of objects are due to and can be explained by the motion of the particles that constitute them
 - First kinetic theory of gases
 - Expressed in probabilistic terms.

What the Renaissance knew



- David Hume (1740)
 - All ideas come from perception
 - "Mind" is a set of "perceptions" or ideas created from perceptions
 - The mind is a theater where perceptions play their parts in rapid succession
 - The self is an illusion
 - The self is like a republic, whose members have an independent life and change all the time but are united by a common constitution
 - The identity of the republic is provided not by its fluctuating contents but by the causal relationship that holds its members together

What the Renaissance knew

- David Hume (1740)
 - Mental life is a series of thoughts, feelings, sensations: “I am nothing but a bundle of perceptions”
 - There is no self
 - A mind is a bundle of inter-related mental events
 - The self is a fiction that we construct in order to define what binds these events together

What the Renaissance knew

- David Hume (1740)
 - The meaning of a word rests on the meaning of all the words it is “associated” with

What the Renaissance knew

- David Hume (1740)
 - Skepticism: critique of causation
 - Experience determines our belief in cause and effect
 - Causality is probability, not certainty (the connection between the two events exists in the mind of the observer, not necessarily between the two events)
 - Induction is not always right: Bacon's scientific method does not always lead to truth
 - From what "is" we cannot infer what "will be"

What the Renaissance knew

- David Hume (1740)
 - Famous example of failed induction: Malthus' predictions were based on thousands of years of human history but failed miserably to predict the future (falling fertility in wealthier societies)

What the Renaissance knew

- David Hume (1740)
 - No absolute truth: any belief is as justified as any other
 - Science is nothing but a set of beliefs shared by the scientific community

What the Renaissance knew

- David Hume (1740)
 - Thought is governed by two laws (associationism):
 - Contiguity: ideas that occur frequently together get associated
 - Resemblance: anything that is associated to an idea is also automatically associated to any similar idea (similar behavior to similar features)

What the Renaissance knew

- David Hume (1740)
 - Proofs of God's existence are flawed
 - Miracles are unproved and unlikely
 - The Christian God is absurd
 - Polytheism was more tolerant than monotheism

What the Renaissance knew

- David Hume (1755)
 - Logical proof that the soul is not immortal

What the Renaissance knew

- Rationalists (Descartes, Leibniz, Spinoza): True a-priori knowledge can be deduced by pure reason. Mathematics is the model for all true knowledge.
- Empiricists (Locke, Berkeley, Hume): True knowledge can only come from experience.
- The victory of empiricism led to western civilization as we know it.

Body-mind debate

- Dualism: mind and body are made of two different substances
 - Substance dualism: the mind is a different (nonphysical) substance altogether from the brain
 - Descartes
 - a substance is characterized by that property that it cannot lack and still be the same substance (extension and “cogito”)
 - Hume:
 - The mind is a theater where perceptions play their part in rapid succession
 - How do mind and body interact?

Body-mind debate

- Monism: only one substance exists
 - Materialism: only matter exists
 - Hobbes
 - Everything is a mechanism
 - Idealism: only mind exists
 - Panpsychism: everything has a mind
 - Leibniz
 - Berkeley
 - The only thing that exists is our mind
 - Pantheism: only God exists
 - Spinoza
 - How does one substance originate from the other?

Body-mind debate

- Dualism
 - Substance dualism
 - Descartes, Hume
- Monism
 - Materialism
 - Hobbes
 - Idealism
 - Berkeley
 - Panpsychism
 - Leibniz
 - Monadology
 - Spinoza

What the Renaissance knew

- Evolution of the Earth
 - Aristotle's paradigm: both living and non-living things classified according to logic
 - The Christian paradigm (human-centered approach): God created the animals and plants that exist as they are today, each animal serving a purpose for humans
 - Animals and plants were classified according to their use

What the Renaissance knew

- Evolution of the Earth
 - Microscopy and geology introduce new species
 - Robert Hooke, "father of microscopy"(1665)
 - First detailed portraits of insects
 - Speculation on the nature of fossils
 - Speculation on the transformation of the Earth since Creation
 - Identification of the living “cell”
 - Robert Hooke applies Bacon's theory

What the Renaissance knew

- Evolution of the Earth
 - Reconstructing the sequence of events that shaped the Earth in ancient times
 - Nicolas Steno: " Prodromus/ Preliminary discourse to a dissertation on a solid body naturally contained within a solid" (1669)
 - Fossils are remnants of living beings of the past
 - The landscape of the Earth was created by rising seabeds

What the Renaissance knew

- **Evolution of the Earth**
 - **John Ray: "History of Animals" (1686)**
 - **The enlightened paradigm: organisms classified according to organic features (return to Aristotle's paradigm but with a strong difference between living and non-living things)**
 - **“Wisdom of God in the Creation” (1691)**
 - **The complexity of living beings implies an intelligent designer**
 - **God designed a fixed number of species**

What the Renaissance knew

- Evolution of the Earth
 - Bernard de Fontenelle: "A Plurality of Worlds" (1688)
 - Copernican view of the Solar system
 - The Earth is just one small planet in a vast universe
 - There are many stars like the Sun
 - They have planets too
 - Thomas Burnet: "Sacred Theory of the Earth" (1691)
 - Physical explanation for the events related in the Bible
 - (eg the Flood was caused by the collapse of the Earth's crust into the underground oceans as divine punishment)
 - William Wiston: "The New Theory of the Earth" (1696)
 - Newtonian explanation of the events related in the Bible
 - The Earth was created by a comet that condensed

What the Renaissance knew

- Evolution of the Earth
 - Robert Hooke: "Discourse on Earthquakes" (1705)
 - The landscape of the Earth was created by catastrophic earthquakes over the Biblical time scale
 - Benoit de Maillet: "Tellamed" (1718)
 - Physical explanation for the genesis of the Earth unrelated to the Bible
 - The landscape of the Earth was caused by retreating oceans
 - All species come from preexisting germs that are spread all over the universe and that mature when they found the proper environment
 - Early members of every species were aquatic
 - Time scale way beyond the Biblical time scale
 - Anton-Lazzaro Moro: "De' Crostacei e degli altri Marini Corpi" (1740)
 - The landscape of the Earth was created by volcanic eruptions

What the Renaissance knew

- Insects
 - Ulisse Aldrovandi (Italy): "De Animalibus Insectis Libri Septem" (1602)
 - Thomas Moffett (Britain): "Insectorum Sive Minimorum Animalium Theatrum" (1634)
 - Maria Sibylla Merian (Holland): "Metamorphosis Insectorum Surinamensium" (1705)

What the Renaissance knew

- Agriculture
 - Rudolf Camerarius/Camerer (Germany)'s "De sexu plantarum epistola" (1694): plants have sex (via pollen)
 - Thomas Fairchild (Britain) creates the first human-made hybrid plant (1717)

What the Renaissance knew

- **Christian Goldbach (1742)**
 - **Every integer is the sum of two primes**

What the Renaissance knew



- Giambattista Vico (1744)
 - There is a single history of humankind, due to the fact that there is a single God, a single Creation, etc
 - The Fall determined the history of humankind
 - The natural sciences cannot explain nature because nature was created by God, and after the Fall humans cannot understand God's mind
 - One can only know one's creations

What the Renaissance knew



- Giambattista Vico (1744)
 - We can know the creations of other humans by using our mind to simulate theirs, but we can never know the creations of God because we cannot simulate his mind
 - Humans can only know history, culture, art and languages

What the Renaissance knew

- Giambattista Vico (1744)
 - The study of human creations (humanities) relies on a method that is different from the study of divine creations (sciences)
 - Languages are the supreme achievement of humans, a consequence of the Fall, as humans got dispersed on Earth

What the Renaissance knew

- Giambattista Vico (1744)
 - Pattern (“corso e ricorso”) of social development in every culture: from barbarism to civilization and then back to barbarism
 - Age of the Gods: religion, language and family emerge from the barbaric state
 - Age of Heroes: social order is created by a class that rules over the other classes
 - Age of Men: the lower classes obtain equality, but cause society to disintegrate

What the Renaissance knew

- Giambattista Vico (1744)
 - This pattern replicates the stages of personal development from child (emotions) to middle age (self-critical) to old age (chaos)
 - The pattern endlessly replicate the pattern of fall, alienation and redemption
 - Pattern of artistic development from poetry to prose
 - Family is the institution that mediates between nature and culture

What the Renaissance knew

- Giambattista Vico (1744)
 - Newton could not conceive of evolution
 - Vico views evolution of language, customs, ideas, culture, politics and even religion

What the Renaissance knew
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