

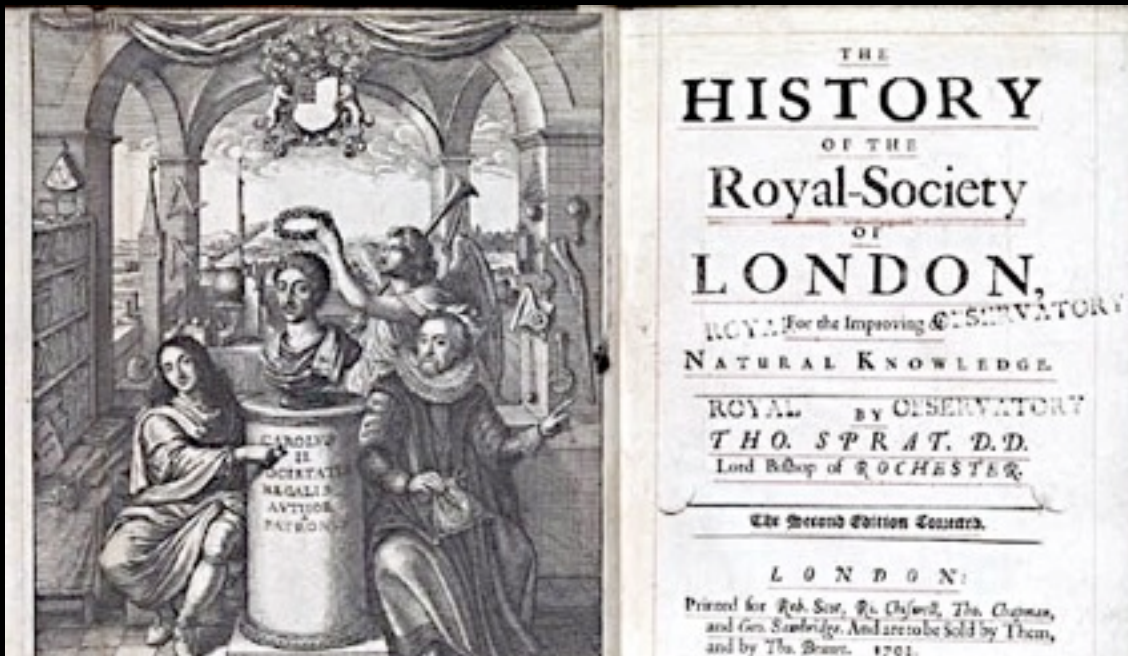


Making of the Western Mind Institute for the Study of Western Civilization Week 24, Science





1. Science in the Ancient World: Greece
Science in the Ancient World: Israel
2. Science in the Middle Ages
3. Science in the Ren-Ref
4. Science and Time
5. Science in the Seventeenth Century



The Birth of Science and the Idea of the Cosmos

ROOTS OF SCIENCE IN THE ANCIENT WORLD



The Greek Origins of Science in the West



Think of Western Civilization as a suspension bridge
It is always in tension and has to be.
Western Pillar is Ancient Greece



Think of Western Civilization as a suspension bridge
It is always in tension and has to be.
Western Pillar is Ancient Greece



Think of Western Civilization as a suspension bridge
It is always in tension and has to be.
Western Pillar is Ancient Greece
Eastern Pillar is Ancient Israel



SOCRATES
PLATO
ARISTOTLE

Abraham
Moses
David
Jesus

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A photograph of a large suspension bridge spanning a deep valley. The bridge has two tall towers and a red-painted deck. The surrounding landscape is mountainous and green. The sky is clear and blue.

SOCRATES
PLATO
ARISTOTLE

Abraham
Moses
David
Jesus

Difference between Western Civilization
and Islamic Civilization?
No Suspension Bridge in Islamic phil/theology.
No tension. All one unity.

The Birth of Science and the Idea of the Cosmos



Cosmos versus Chaos



The **cosmos** is a complex and orderly system;

the opposite of chaos.

It is the universe regarded as an ordered system.

Cosmic Order (Word Cosmos in Greek MEANS Order)

Cosmos versus Chaos



In other words:
For the Greeks
The Divine Order
of the Universe
The Unmoved Mover
(Aristotle)
all signified
a fundamental order
in all of creation
all the universe.







Ionian
Coast
of
Asia
Minor
(Turkey)

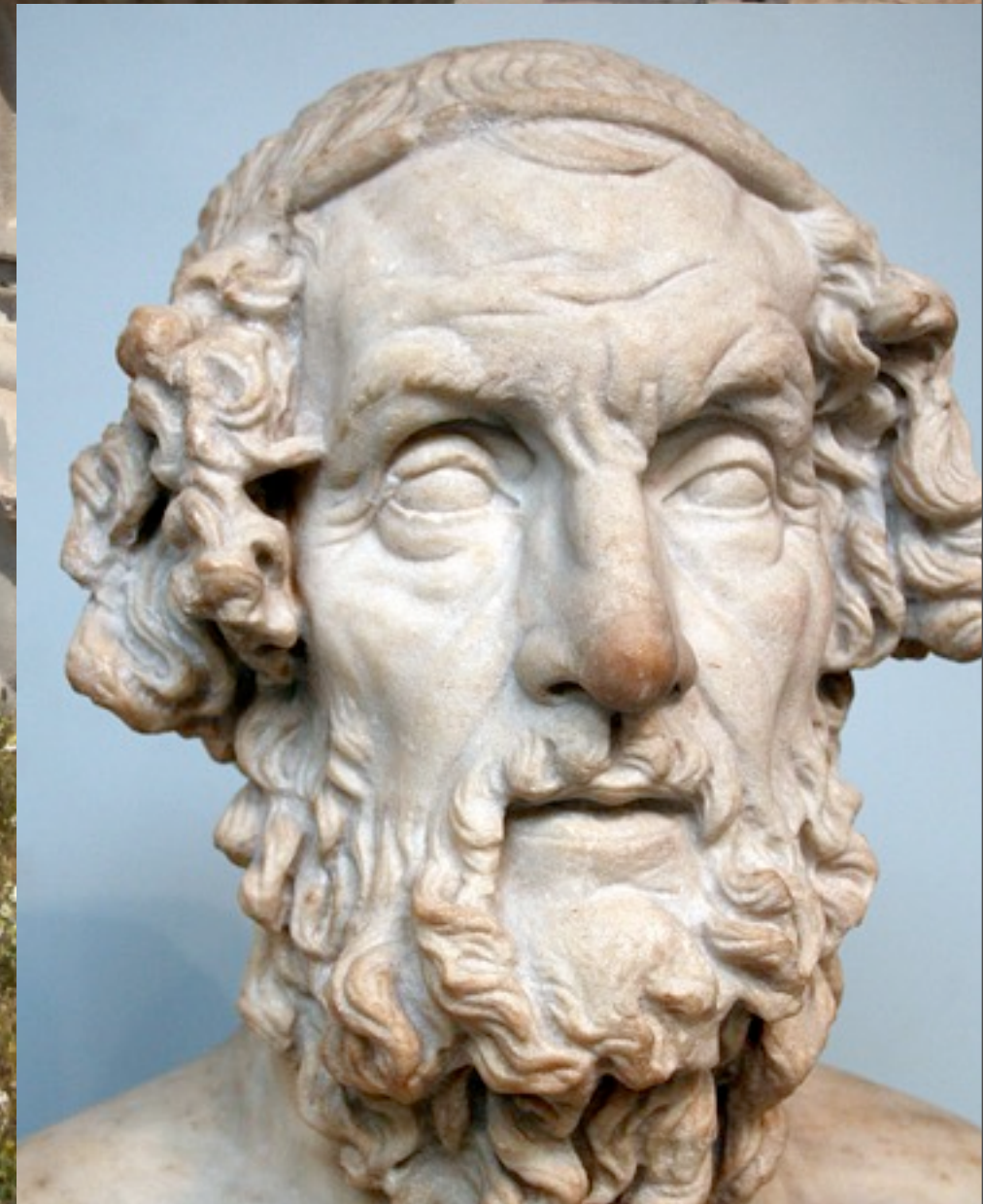


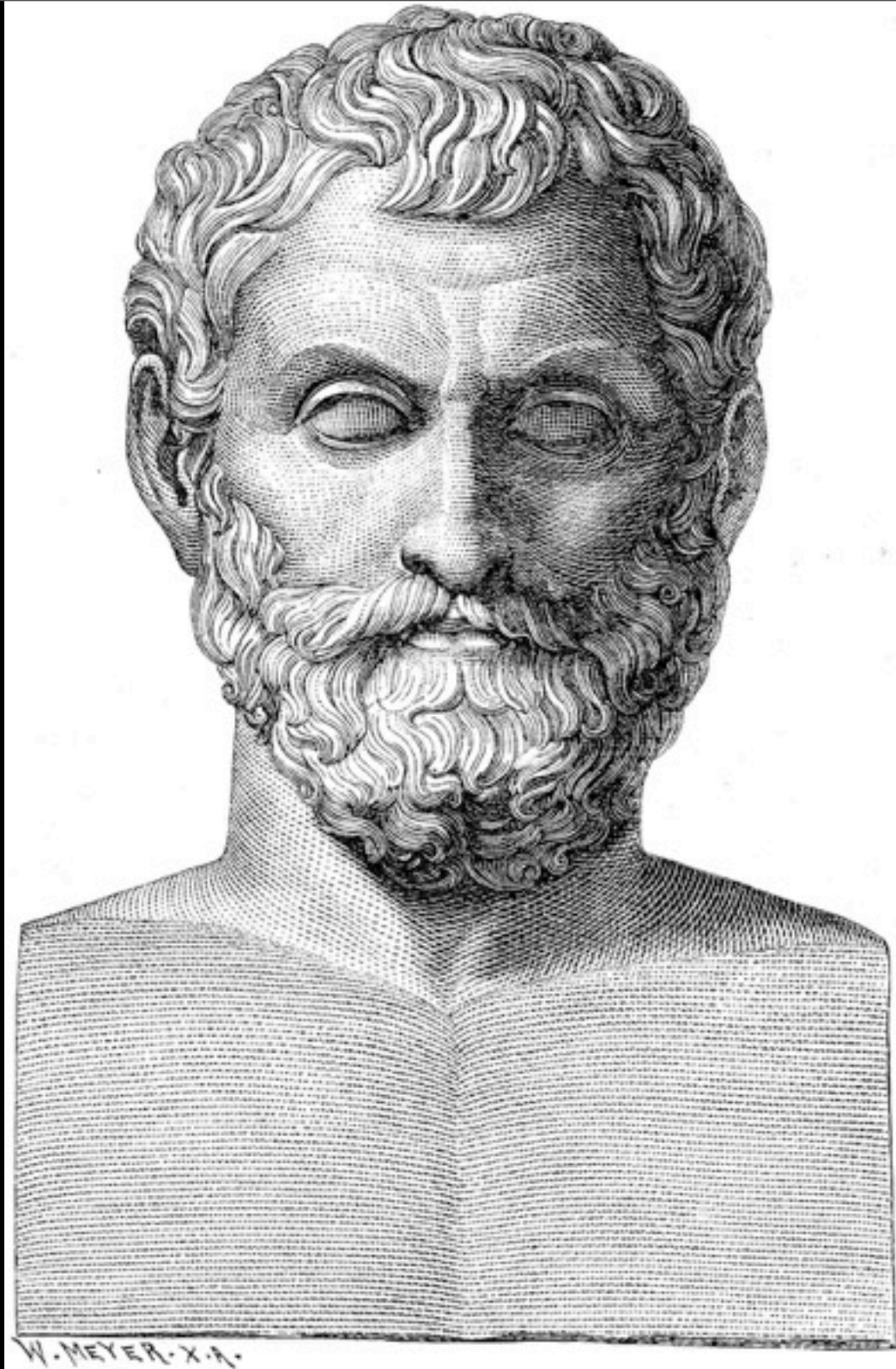
The Ionian Coast
of Asia Minor
700-500 BC
Smyrna
Colophon
Ephesus
Samos
Miletus
Halicanarsus
(World of
Homer 770-700BC)



1. Expanding exploring commercial society.
2. Political Constitutional experimentation
3. Intellectual experimentation. Philosophy.
4. Alphabetic writing from Phoenicians and papyrus from Egypt.

Homer in Smyrna, 770-700 BC





Thales of Miletus, 624 - 546 BC

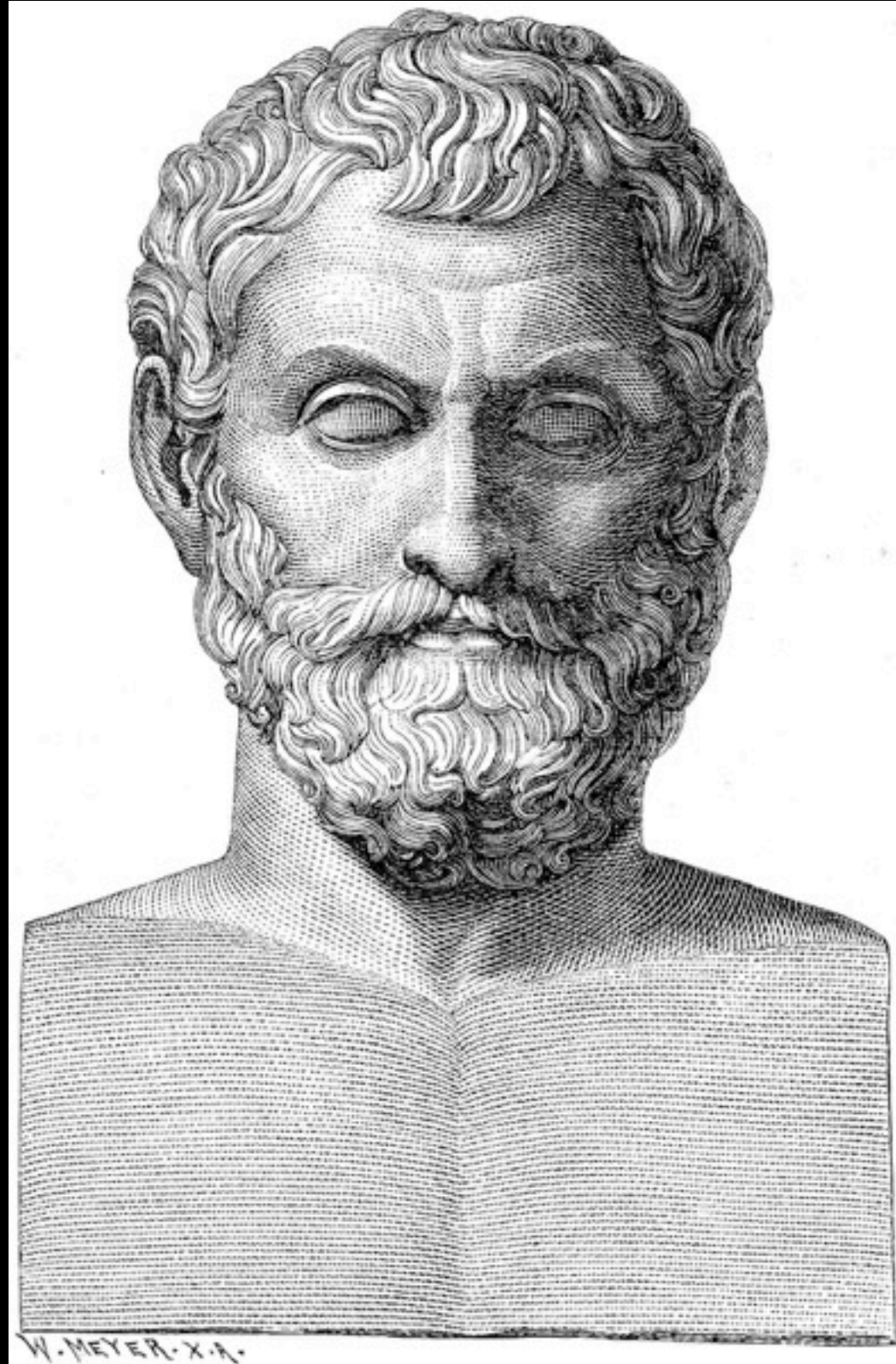
Bertrand Russell: "Western philosophy begins with Thales."

The Presocratic philosophers (Before Socrates) Thales, Anaximander,

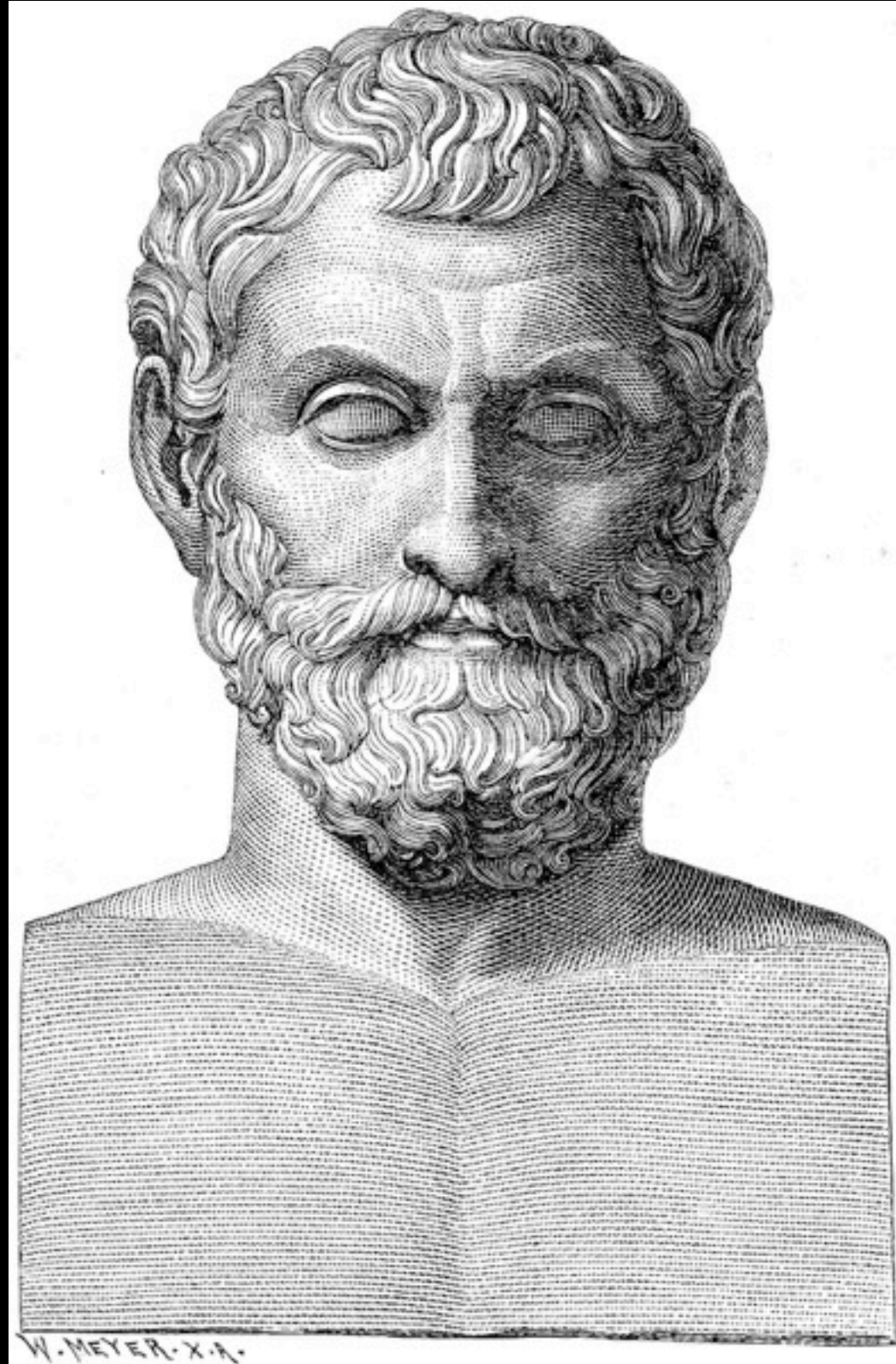
rejected traditional mythological explanations of the phenomena they saw around them in favor of more rational explanations.

These philosophers asked questions about "the essence of things":

- From where does everything come?
- From what is everything created?
- How do we explain the plurality of things found in nature?
- How might we describe nature mathematically?

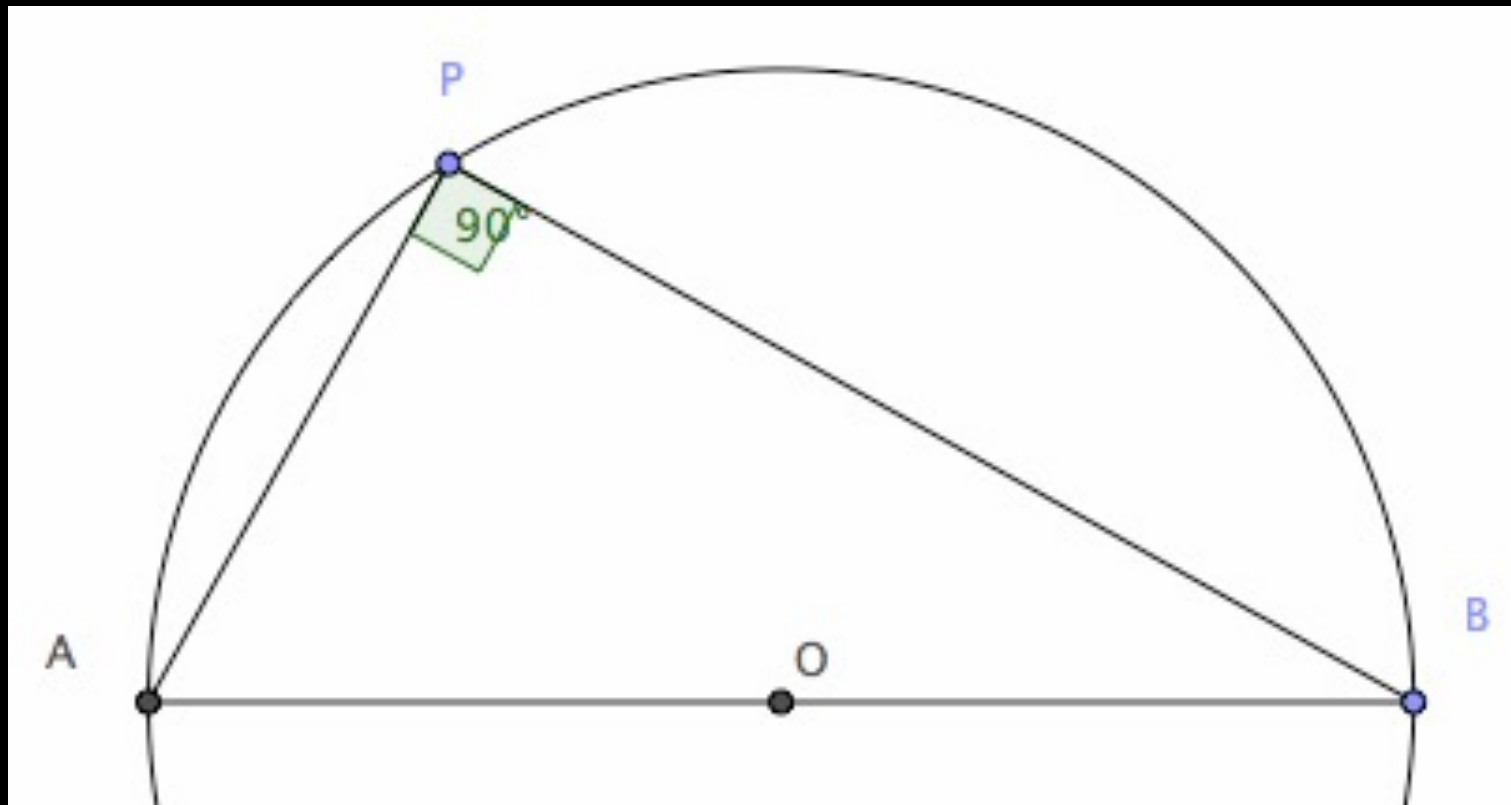


Almost all of the other
Pre-Socratic
philosophers follow him
in attempting to provide
an explanation of
ultimate substance, and
the existence of the
world without reference
to mythology. Those
philosophers were also
influential and
eventually Thales'
rejection of mythological
explanations became an
essential idea for the
scientific revolution



In mathematics, Thales used geometry to solve problems such as calculating the height of pyramids and the distance of ships from the shore. He is credited with the first use of deductive reasoning applied to geometry. As a result, he has been hailed as the first true mathematician and is the first known individual to whom a mathematical discovery has been attributed.

Thales' Theorem



In geometry, **Thales' theorem** states that if A, B and C are points on a circle where the line AC is a diameter of the circle, then the angle $\angle ABC$ is a right angle. It is generally attributed to Thales of Miletus, who is said to have offered an ox (probably to the god Apollo) as a sacrifice of thanksgiving for the discovery,

Anaximander, 610-546 BC, Miletus



He belonged to the Milesian school and learned the teachings of his master Thales. He succeeded Thales and became the second master of that school where he counted Anaximenes and maybe Pythagoras amongst his pupils.



Pythagoras,
570-495 BC
born at Samos
island off coast
of Asia Minor



Pythagoras, 570-495 BC
born at Samos island off coast
of Asia Minor. He and his
disciples believed that
everything was related to
mathematics and that
numbers were the ultimate
reality. It was said that he
was the first man to call
himself a philosopher, or
lover of wisdom, and
Pythagorean ideas exercised
a marked influence on Plato
& Aristotle and through them,
all of Western philosophy.









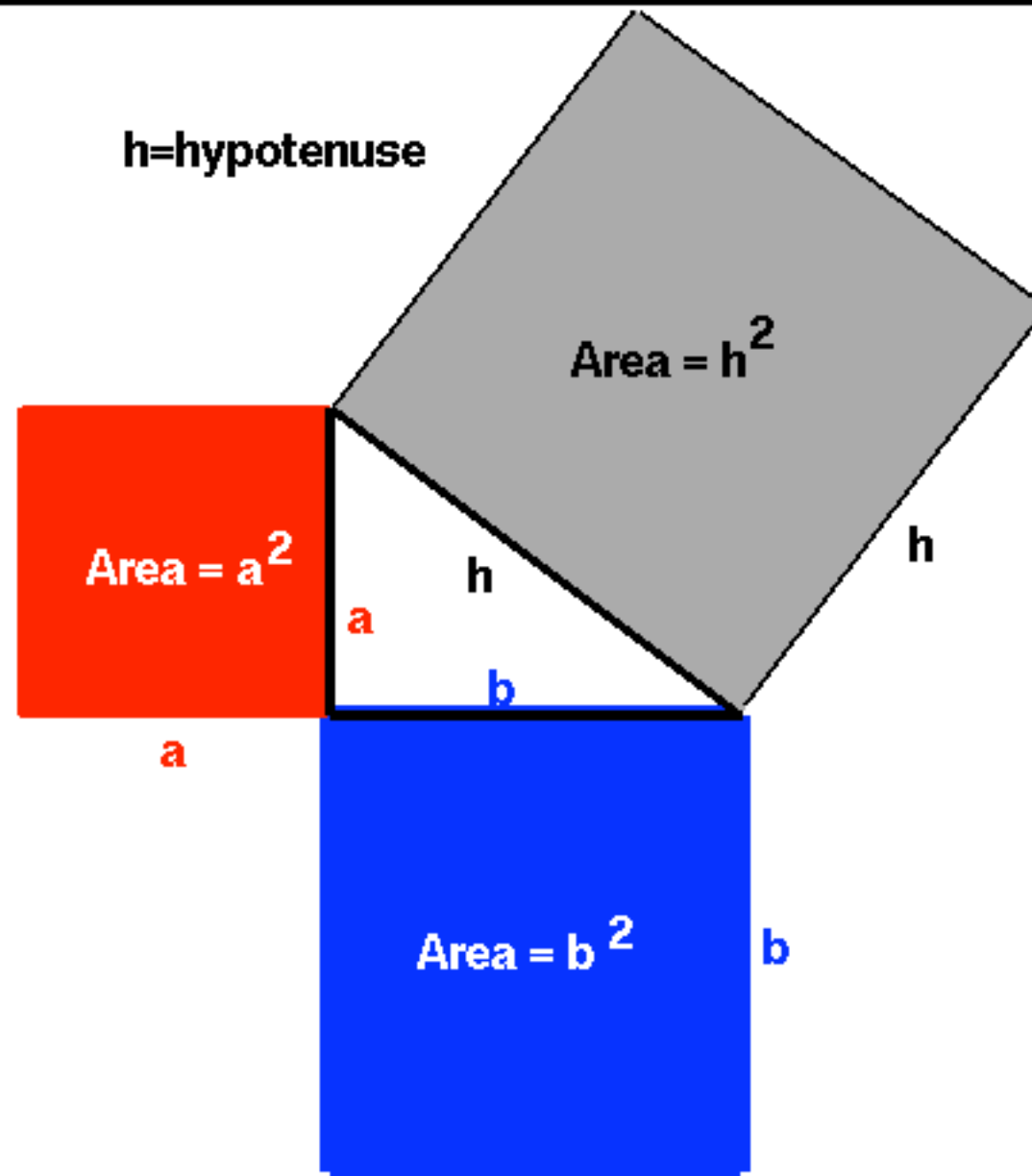


Pythagorean Theorem

Glenn
Research
Center

For any right triangle with sides a and b and hypotenuse h , the square of the hypotenuse is equal to the sum of the squares of the other two sides.

$$h^2 = a^2 + b^2$$





Anaxagoras, 510 - 428 BC
Athens, friend of Pericles

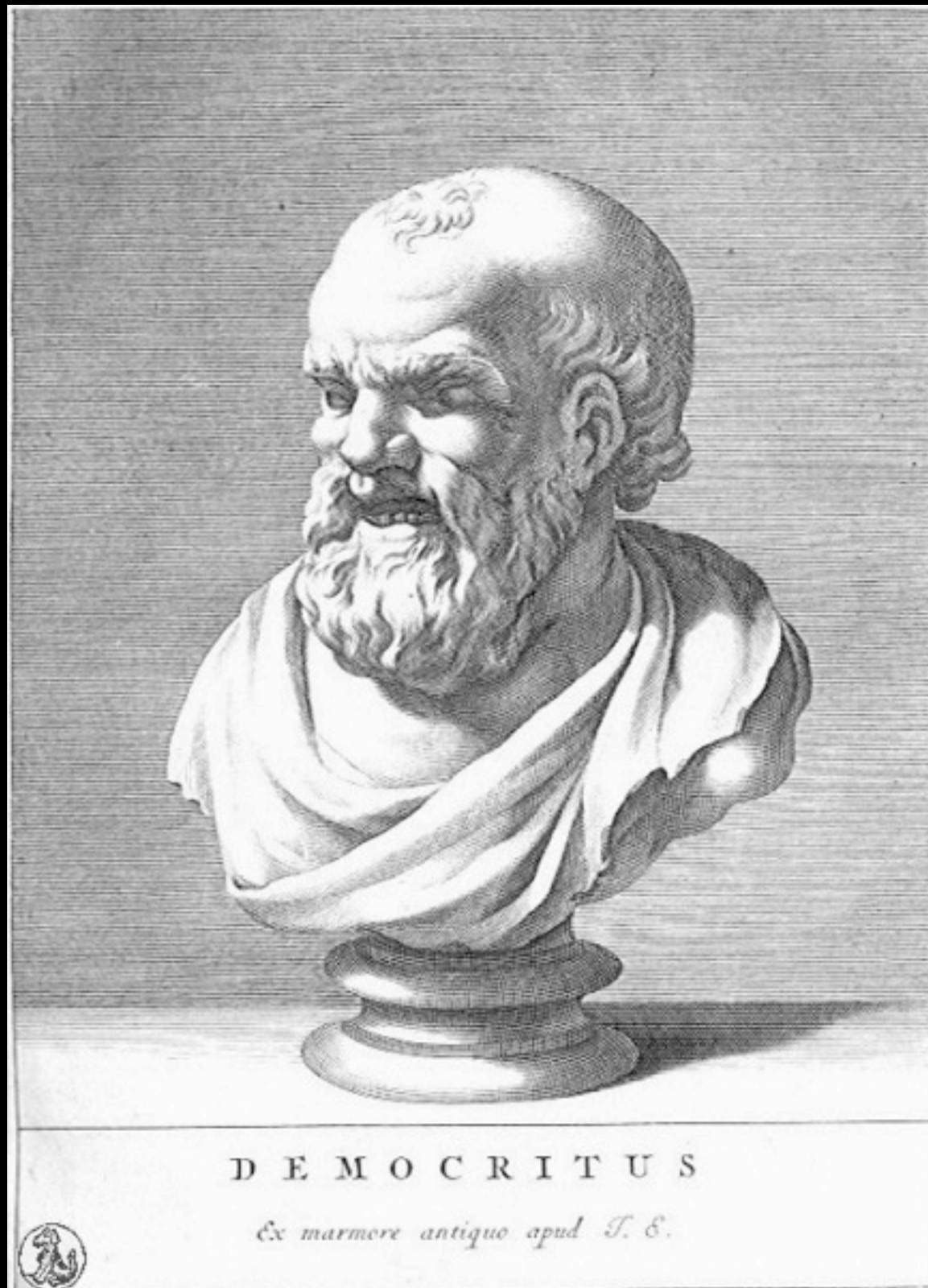
The entire cosmos is a Mind (Nous). It was this Mind that made all things and put them in motion. "Mind is unlimited and self ruled and is mixed with no thing, but is alone and by itself It is the finest of all things and the purest, and it has all judgment about everything and the greatest power." In this way Anaxagoras articulated an early form of monotheism

Thus it is easy to see how one could MERGE
Greek Nous to Jewish Yahweh

Democritus 460-370

The Atomic Theory

The theory of Democritus held that everything is composed of "atoms", which are physically indivisible; that between atoms, there lies empty space; that atoms are indestructible; have always been, and always will be, in motion; that there are an infinite number of atoms.



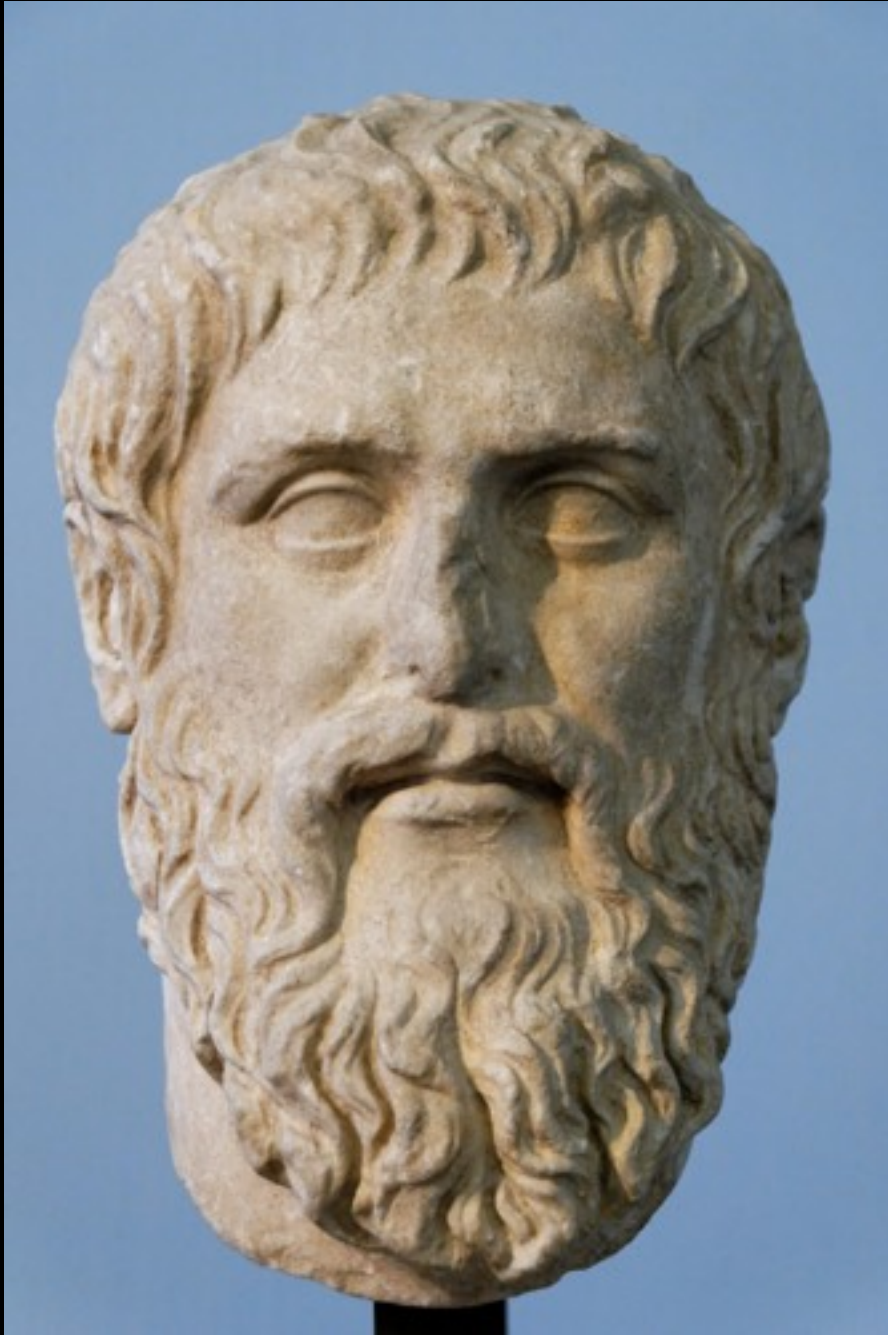


Aristotle tutoring Alexander,
Begins 343 BC

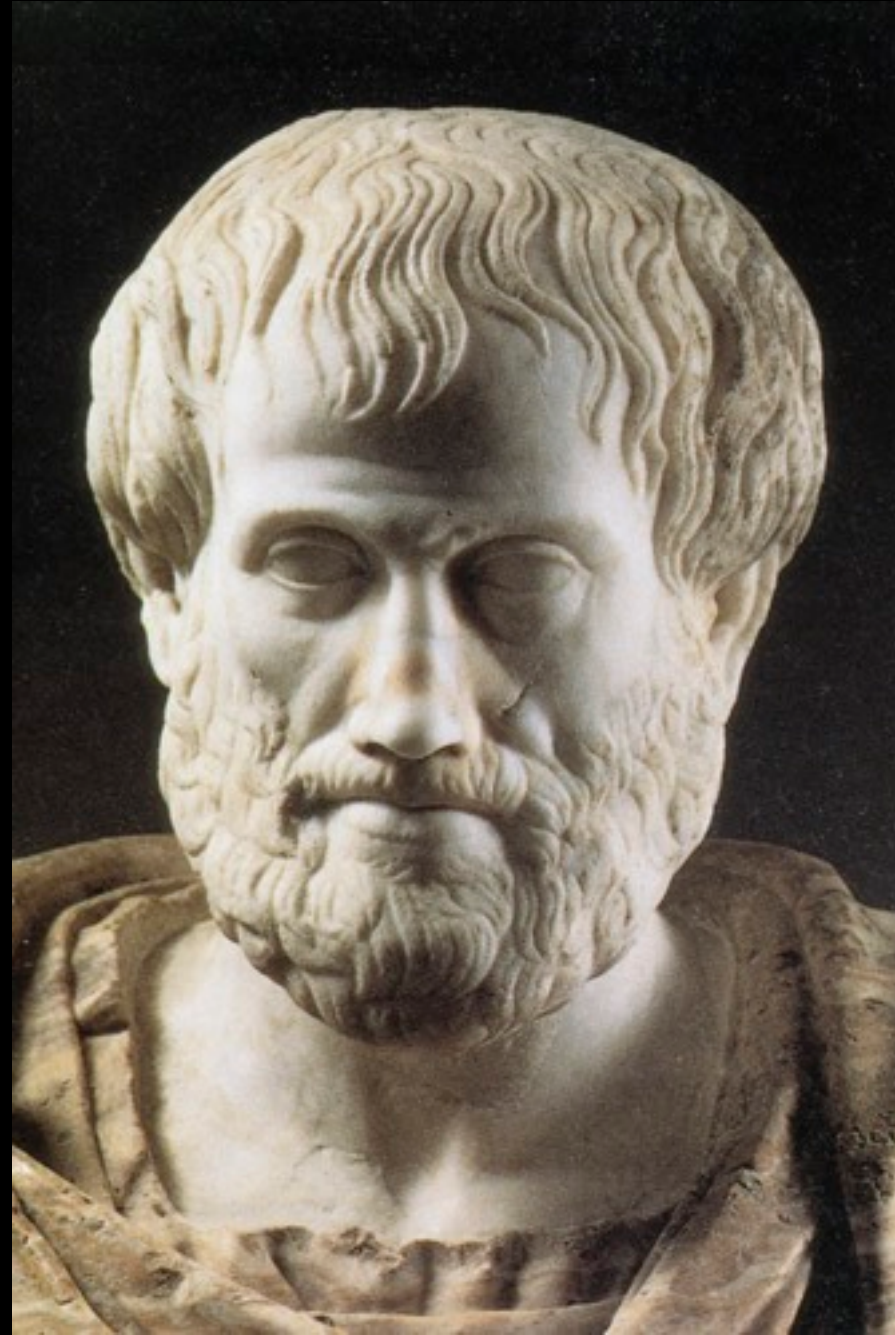








Plato
427-347 BC



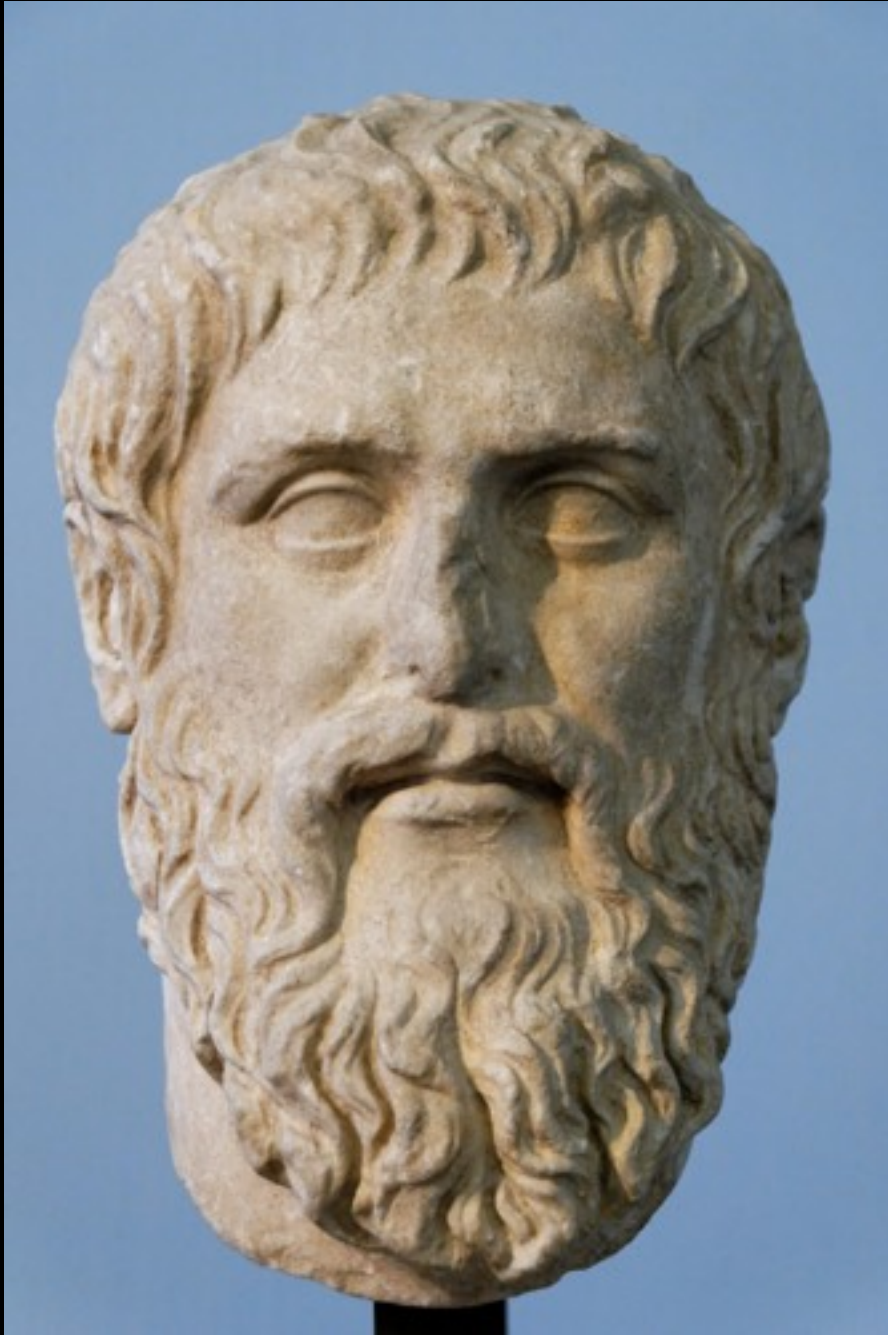
Aristotle
384-322 BC

Cosmos versus Chaos

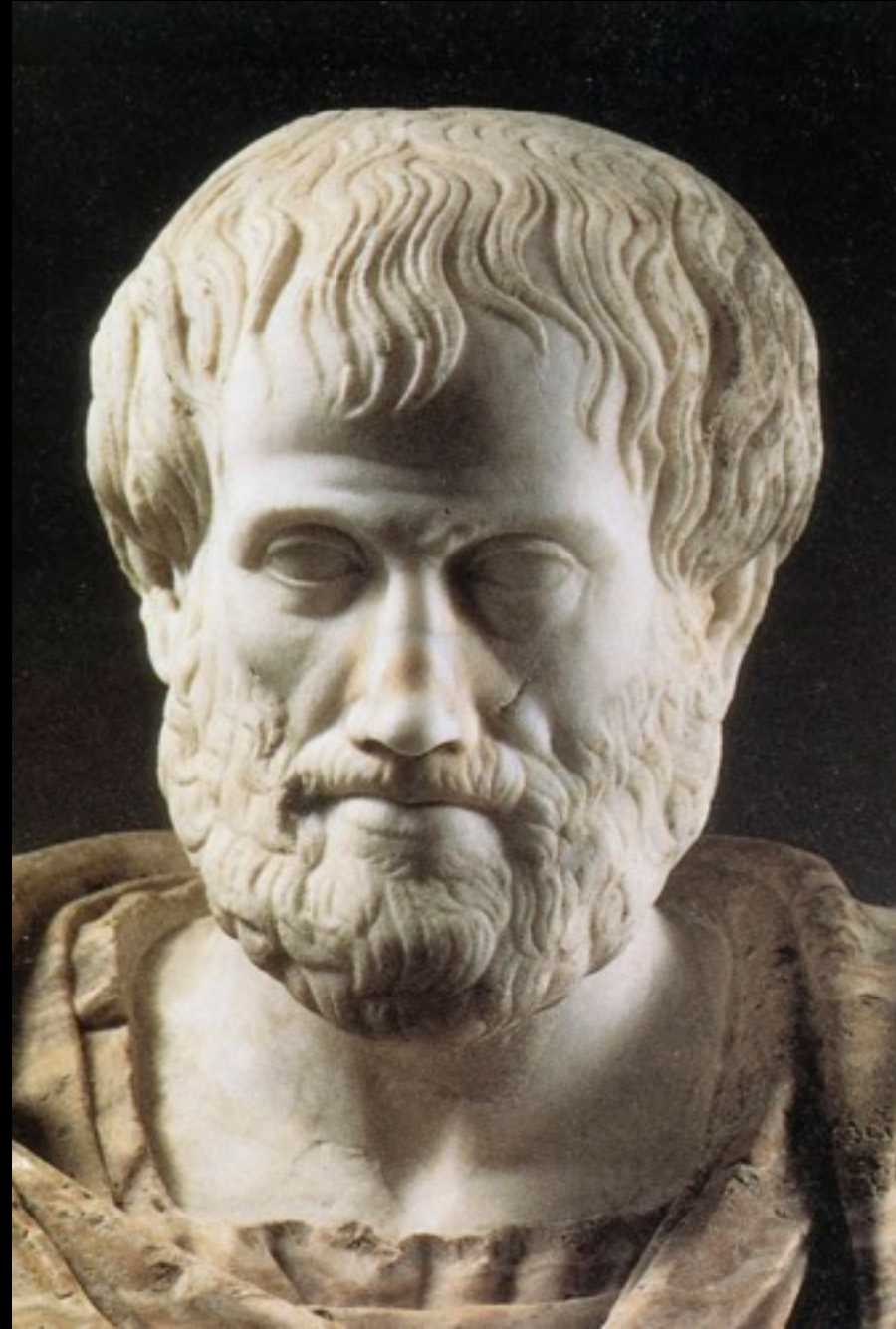


In other words:
For the Greeks
The Divine Order
of the Universe
The Unmoved Mover
(Aristotle)
all signified
a fundamental order
in all of creation
all the universe.

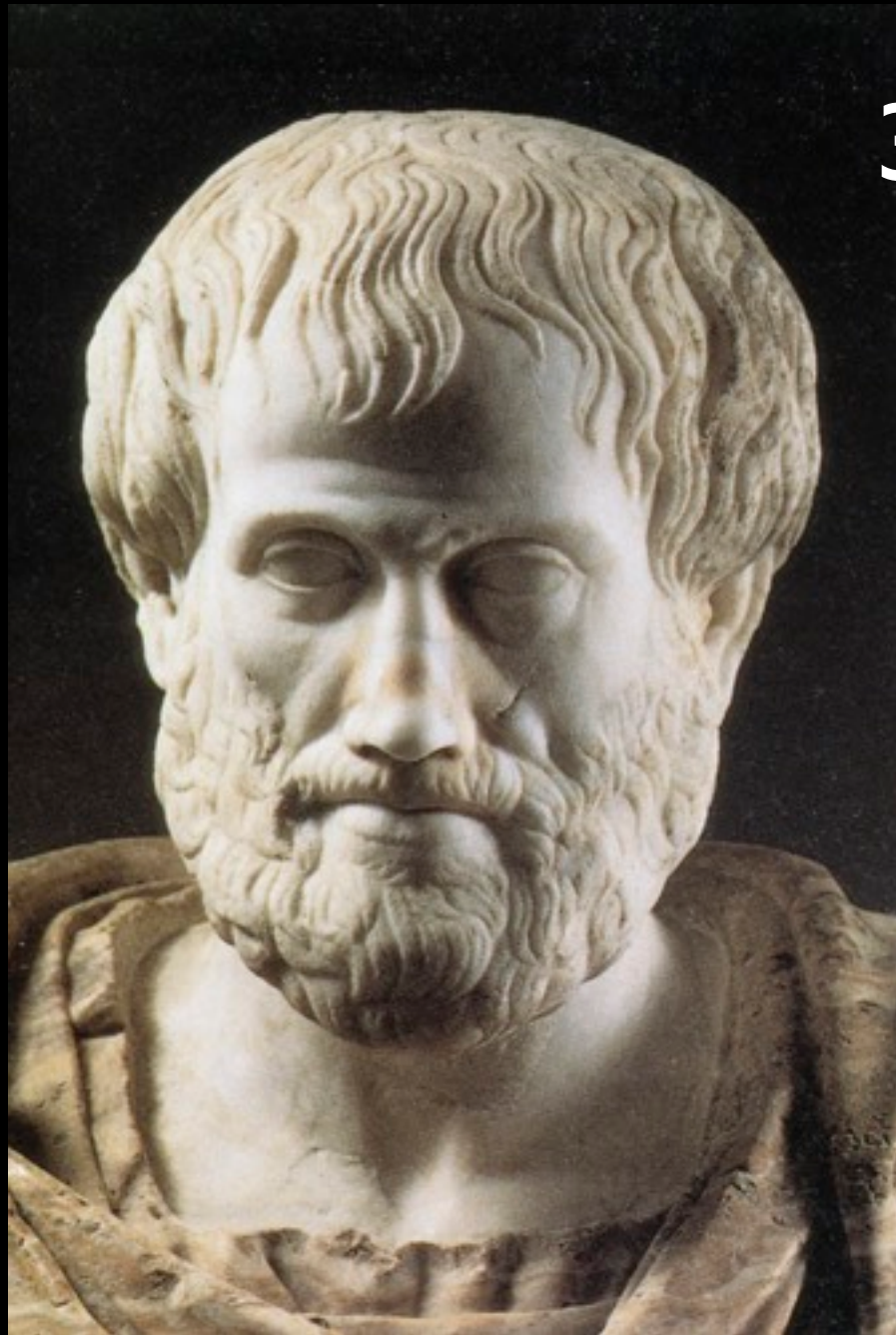
Cosmic Order (Word Cosmos MEANS Order)



Plato
427-347 BC

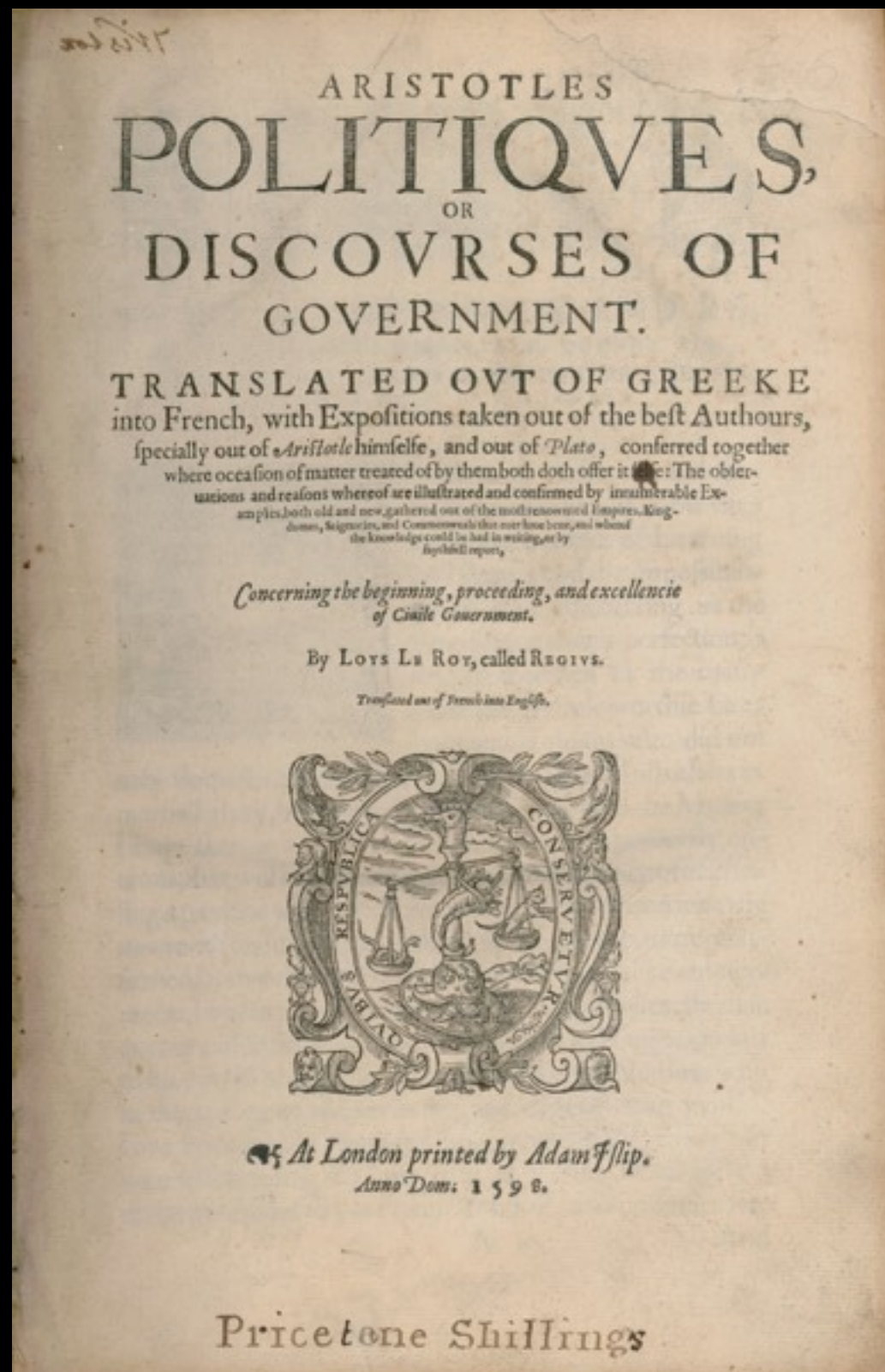


Aristotle
384-322 BC

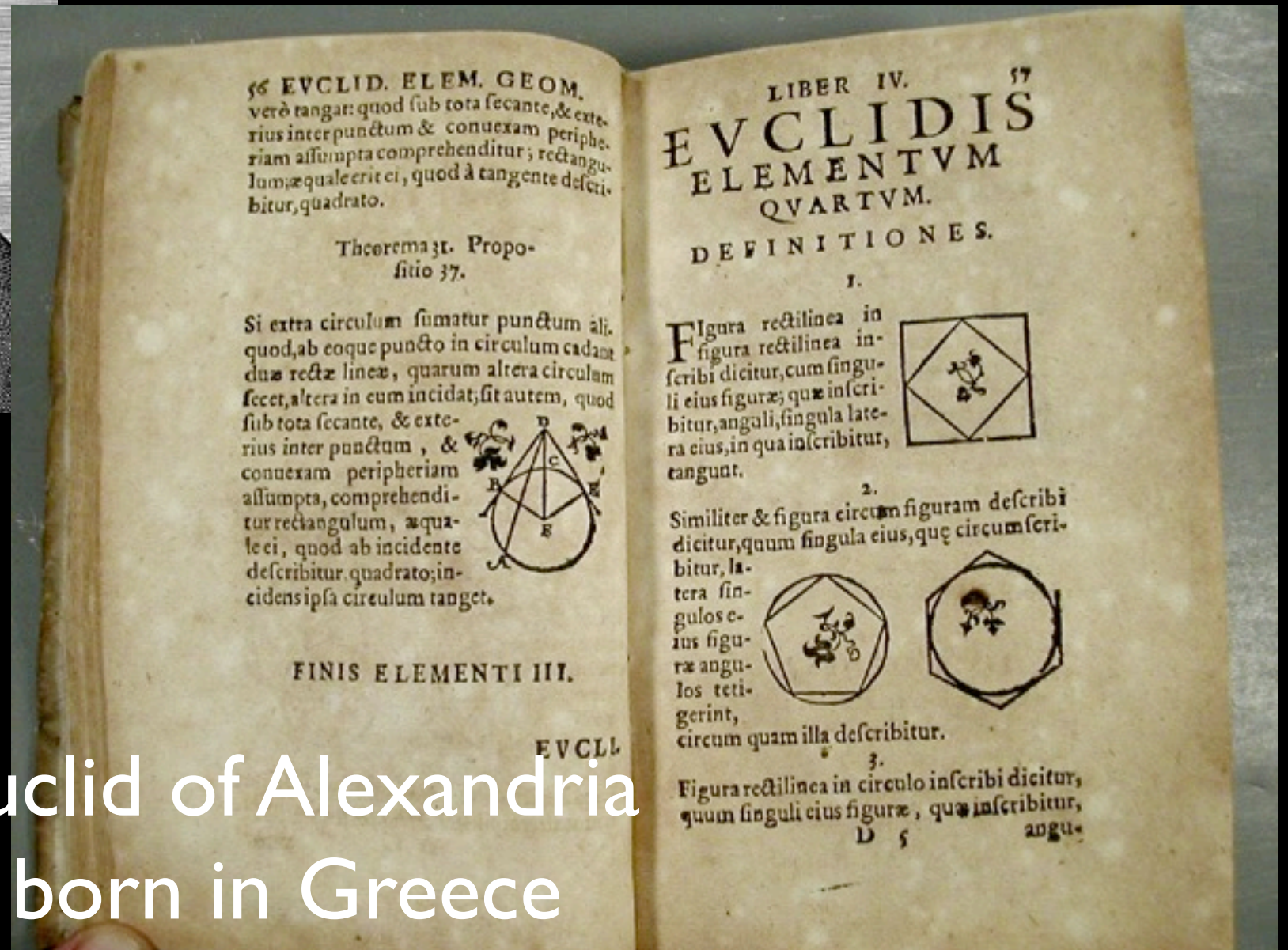


Aristotle
384-322 BC

384, born Stagira, Macedon
364 Athens studying with Plato
343 Macedon, tutor to Alexander
336 Assass. of Philip II
334, Alexander on the road
334, Aristotle to Athens
set up school (Lyceum)
334 Alexander sends huge
donation for school
333 Alexander sends plants
animals to Arist (Botany etc)
334-322 Aristotle writes books
323 death of Alexander
Aristotle leaves Athens
322 Aristotle dies at Chalcis



Aristotle's Books
Wrote 400 Works
1. Logical Works
“categories” “Topics”
2. Scientific Works
Physics, Meteorology
3. Aesthetic Works
Poetics
4. Philosophical Works
“Metaphysics” “Ethics”
“Politics”



Euclid of Alexandria
born in Greece

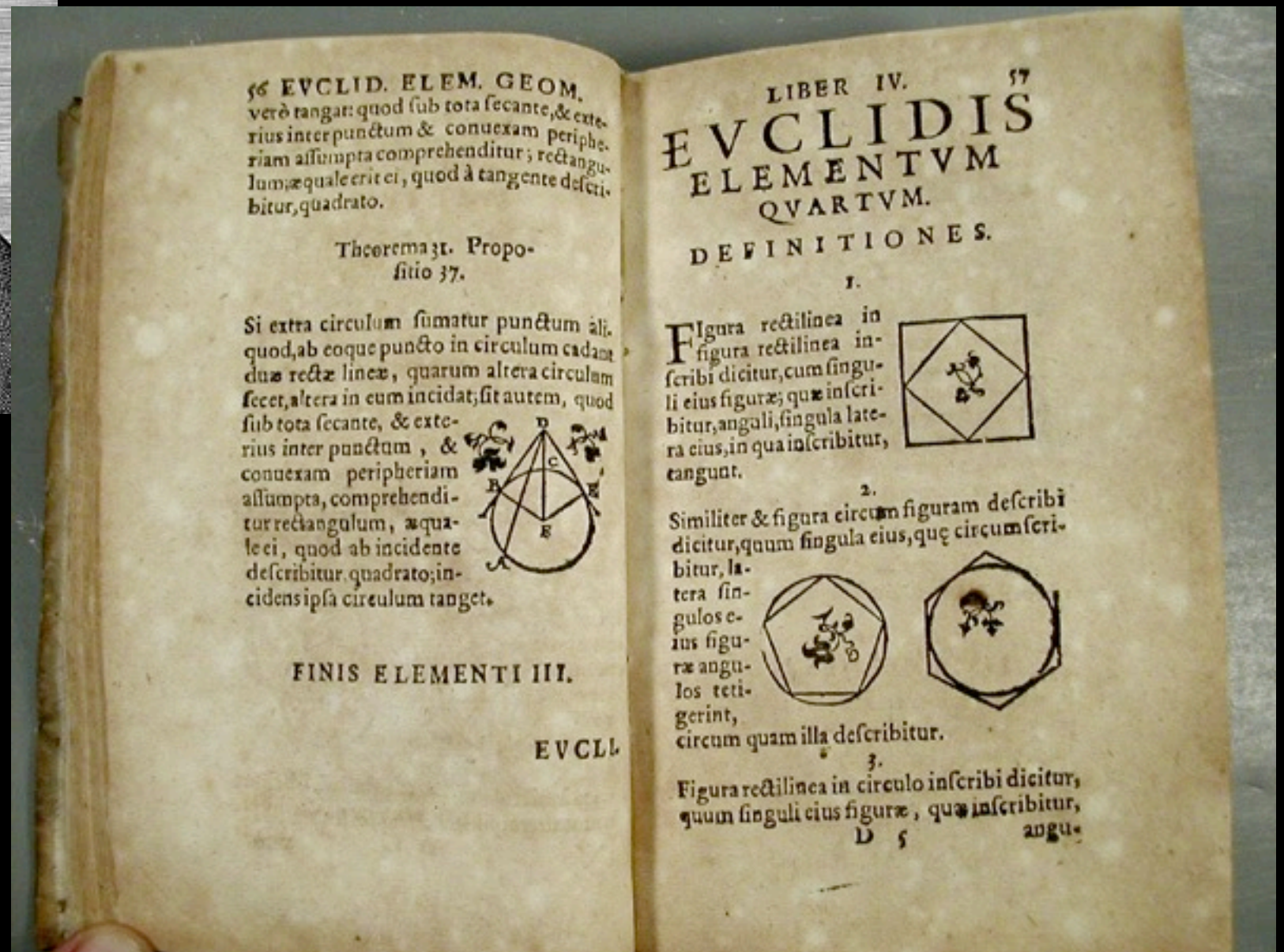
spent time in Athens

knew members of the Platonic academy

moved to Egypt in the Post-Alexander period

Alexandria the center of science has great library

Elements published sometime around 300 BC



In the *Elements*, Euclid deduced the principles of what is now called Euclidean geometry from a small set of axioms. Euclid also wrote works on perspective, conic sections, spherical geometry, number theory and rigor. *The Elements* has been read for 2300 years without interruption



Ptolemy of Alexandria
100 - 170 AD
(Greek language)
The Almagest
and
The Geography

The Geography gives us
a complete version
of latitude and longitude



Ptolemy of Alexandria

100 - 170 AD

The Geography

posits a
**GEOCENTRIC
UNIVERSE.**

(Greeks all agreed)

Columbus carries copy of
The Geography maps
with him
he will begin the
dismantling
of the Ptolemaic universe.

Cosmos versus Chaos



The Divine Order
of the Universe

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(Aristotle)

all signified
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in all of creation
all the universe.

Cosmic Order (Word Cosmos MEANS Order)

The Birth of Science and the Idea of the Cosmos





1. Science in the Ancient World: Greece
Science in the Ancient World: Israel
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The Birth of Science and the Idea of the Cosmos

The Birth of Science and Ancient Israel

ROOTS OF SCIENCE IN THE ANCIENT WORLD

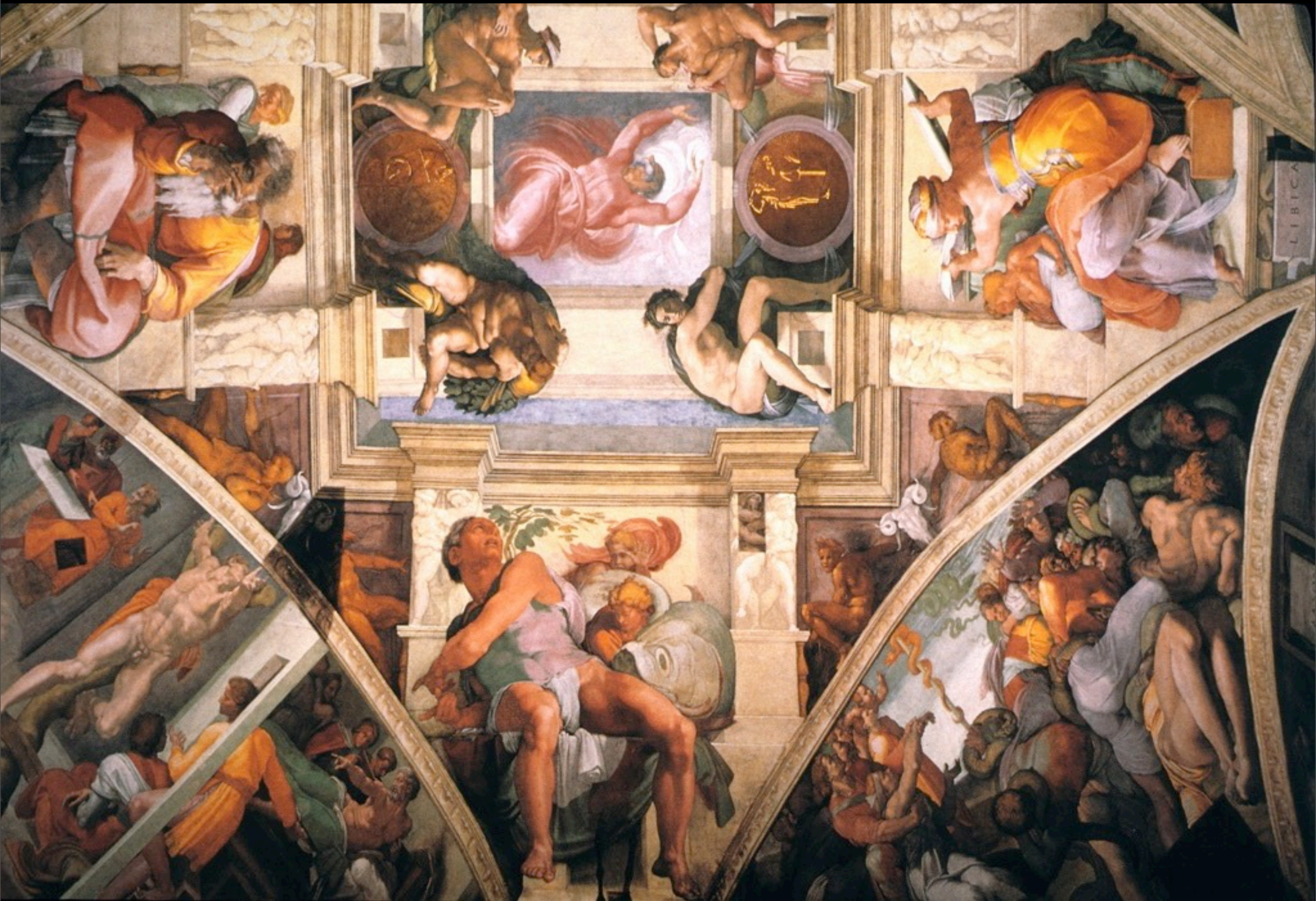


Think of Western Civilization as a suspension bridge
It is always in tension and has to be.
Western Pillar is Ancient Greece
Eastern Pillar is Ancient Israel



Abraham
Moses
David
Jesus







Genesis Chapter 1 , King James
1. In the beginning God
created the heaven and the
earth.



- GOD CREATES DAY AND NIGHT
- CREATES DIVISIONS OF TIME
- CREATES TIME
- CREATION TAKES PLACE IN TIME
(AUGUSTINE)•

CREATION: BOTH IN TIME AND CREATES TIME



And let them be for lights in the firmament of the heaven to
give light upon the earth: and it was so.

- TIME AND HISTORY RIGHT FROM START
- CREATION A HISTORICAL STORY 7 DAY STORY
- CREATION BEGINS TIME
- IT ALL STARTS NOW NO CYCLES



And God blessed the seventh day, and sanctified it: because that in it he had rested from all his work. . . .

- JEWS AND SEVEN DAY WEEK AND THE SABBATH
- GENESIS 7 SEVEN DAY WEEK CREATES FRAMEWORK FOR EXPERIENCE
- CREATION OF WEEK LIBERATES MAN FROM TYRANNY OF SUN
- FIRST GREAT STEP IN MAN'S LIBERATION, MAN'S FREEDOM
- **MAN-MADE WEEK ALLOWS HOURS
HOURS ALLOW MINUTES
MINUTES ALLOW SECONDS(= SCIENCE)**



CAREFUL MEASUREMENT OF TIME ESSENTIAL TO SCIENCE

**ALL THIS ORGANIZATION OF TIME IS THE MOST BASIC BUILDING
BLOCK FOR ALL WESTERN SCIENTIFIC AND TECHNOLOGICAL
ADVANCES**

**MOST IMP RESULT OF GEN VISION; WEEK=DIVISIONS OF TIME
AND DIV OF TIME ALLOW HISTORY-HISTORY IS THE MOST
CHARACTERISTIC HERITAGE TO ALL THE WEST FROM JEWS.**

HISTORY; GOD'S CREATION ON THE MOVE.



The
Ancient
Jews
give us
the week.

Time
Week
Clock
Science





And to rule over the day and over the night, and to divide the night from darkness: and God saw that it was good.

THE ORDER OF THE UNIVERSE; ALL THE PIECES FIT



And to rule over the day and over the night, and to divide the night from darkness: and God saw that it was good.

THE ORDER OF THE UNIVERSE; ALL THE PIECES FIT



NATURE OF THIS GOD

- 1) ALL ALONE ; NO GOD-FIGHT
- 2) HIS WORD IS FINAL; NO REVERSALS
- 3) HE IS TOTALLY FREE ; COULD DO OTHER

GOD GENESIS MAN-WOMAN SCIENCE

GOD CREATES MAN IN HIS OWN IMAGE

- MAN SPECIAL FROM BEGINNING: "GODLIKE"
- ONE OF MOST POWERFUL OF WESTERN IMAGES
- MAN LIKE GOD; MAN IS CREATED "FREE"
- GOD MAKES MAN FREE IN A WORLD GOVERNED BY GOD'S PURPOSE
- WHEN MAN ABIDES BY GOD'S LAWS HE WILL REALIZE BEST IN HIMSELF
- HE IS PART OF GOD'S PLAN AND GOD'S WORLD
- MOST IMPORTANT: MAN'S FREEDOM MEANS HE CAN MAKE HISTORY
- **HE CAN CHANGE THINGS;
HE CAN ACT ON NATURE**



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The Birth of Science and the Idea of the Cosmos

The Birth of Science and Ancient Israel

ROOTS OF SCIENCE IN THE ANCIENT WORLD





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Science in the Middle Ages



Fourth Century:
Christian theologians
like Augustine
see possible merging of
Greek & Judeo-Christ
traditions.
That is good for
Science.

Augustine of Hippo,
354 - 430 (76)



“Quid
Athenae
Hierosolymis?”



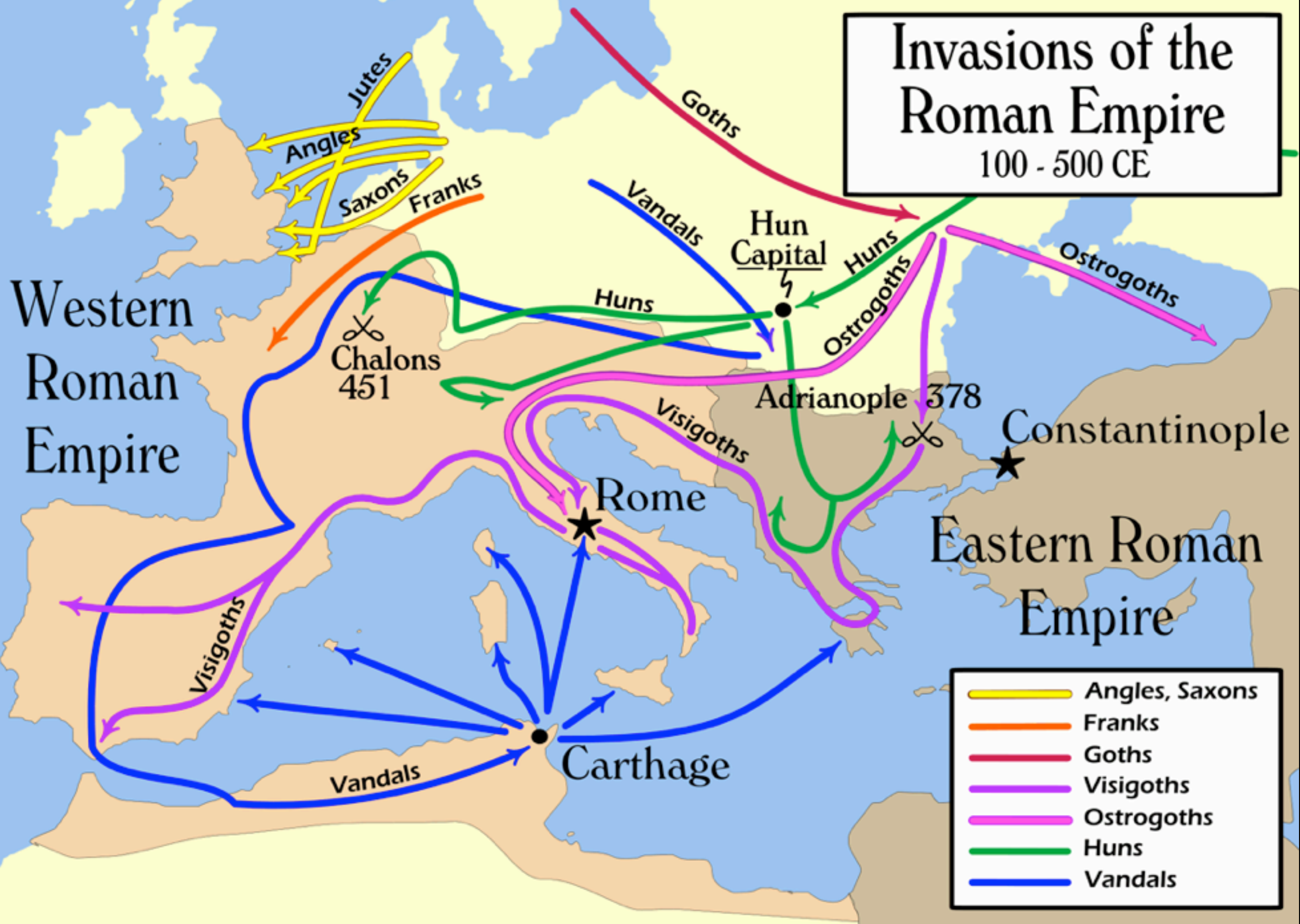
“What does
Athens
Have to
do with
Jerusalem?”

Invasions of the Roman Empire

100 - 500 CE

Western Roman Empire

Eastern Roman Empire



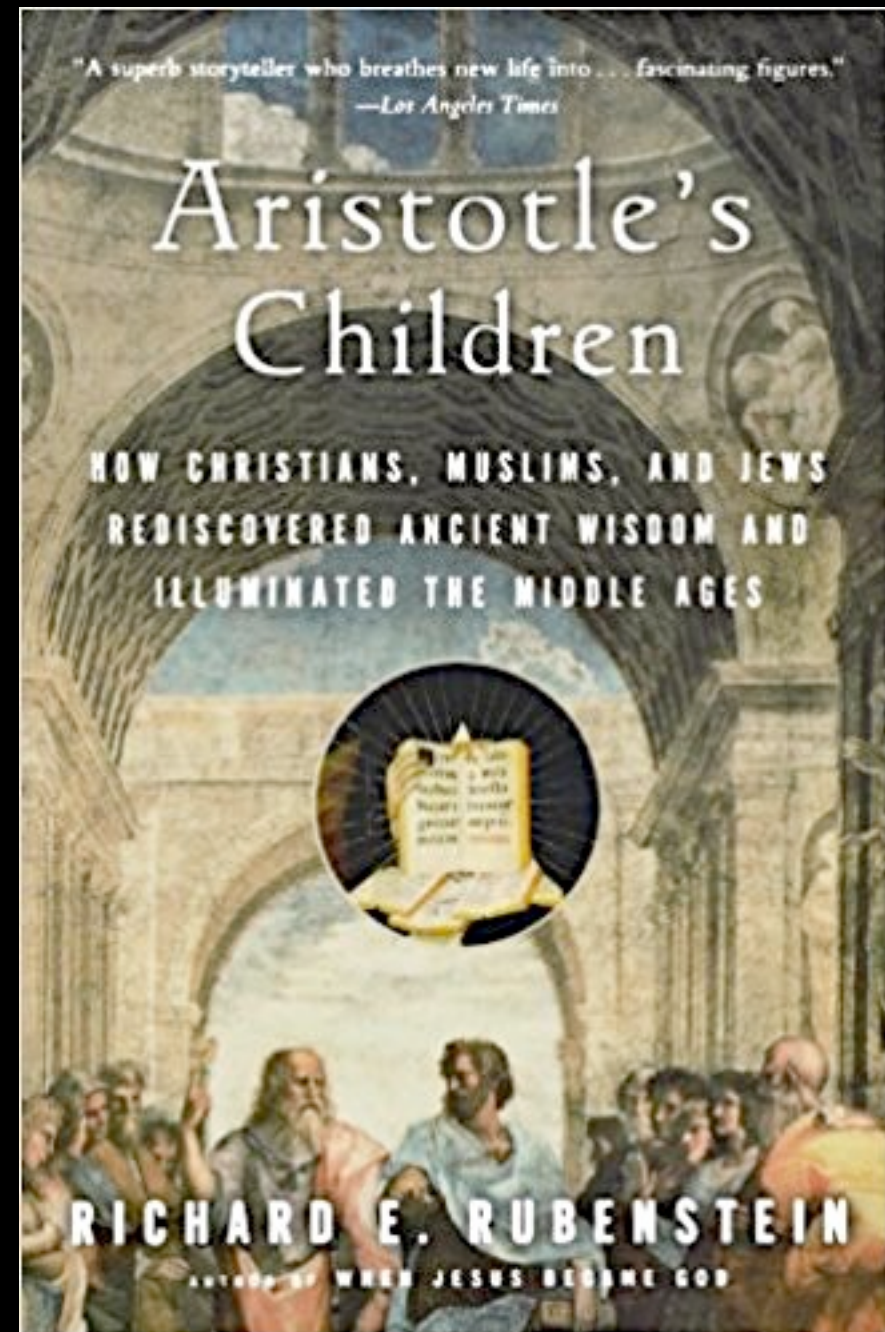






Constantine, mosaic in Hagia Sophia
Edict of Milan 313

Greek and the Greek Philosophers

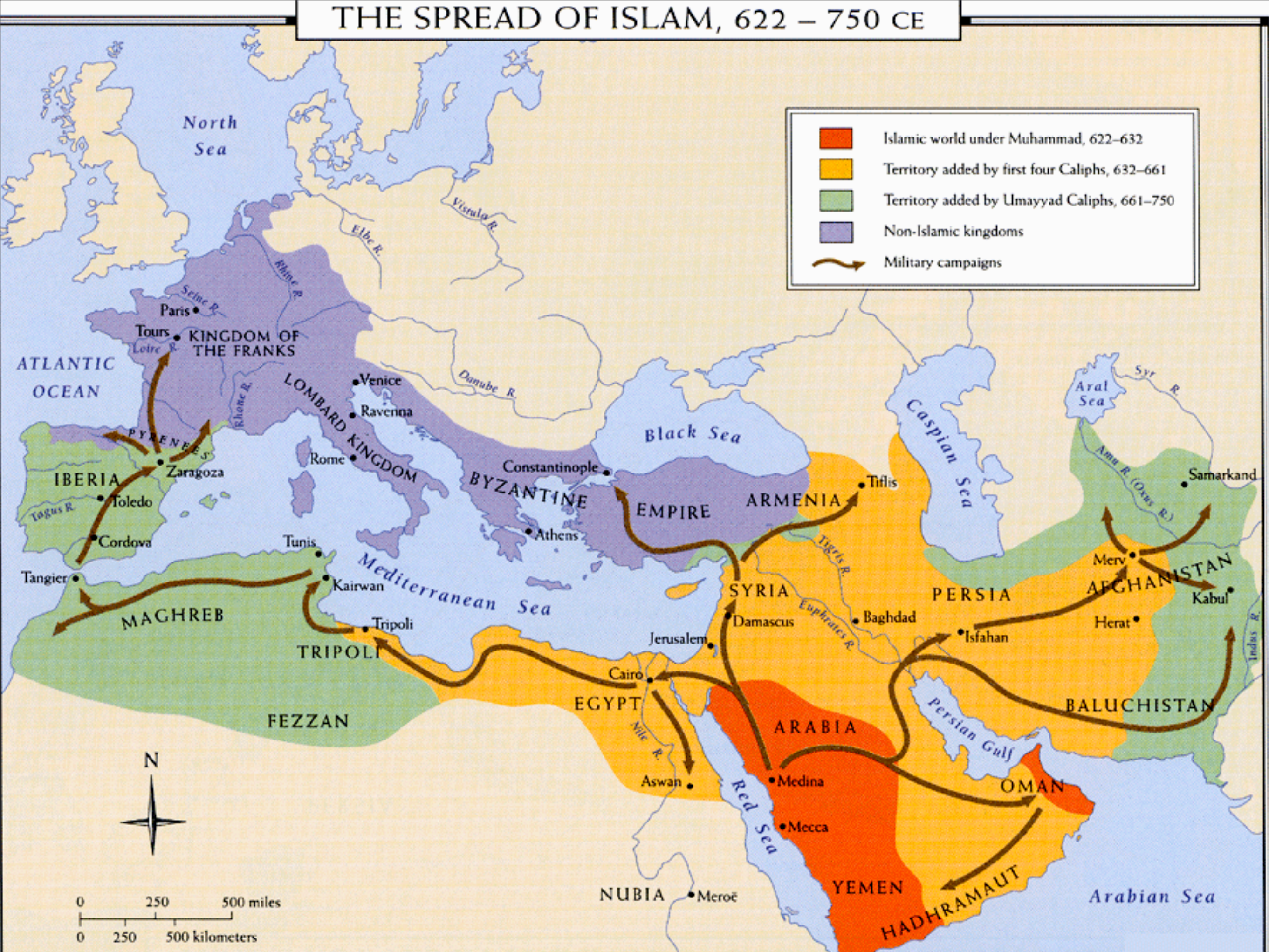


Survival of the the Greek Philosophers
Constantinople, Baghdad, Toledo, Florence



500s Monasticism: Monte Cassino, Benedict, Rule 529
work, pray, copy the texts, build the libraries

THE SPREAD OF ISLAM, 622 – 750 CE



Continuity of Greek knowledge from Constantine to 1453



But since everything is destroyed in 1453, vital to know where the knowledge has gone **BEFORE 1453**

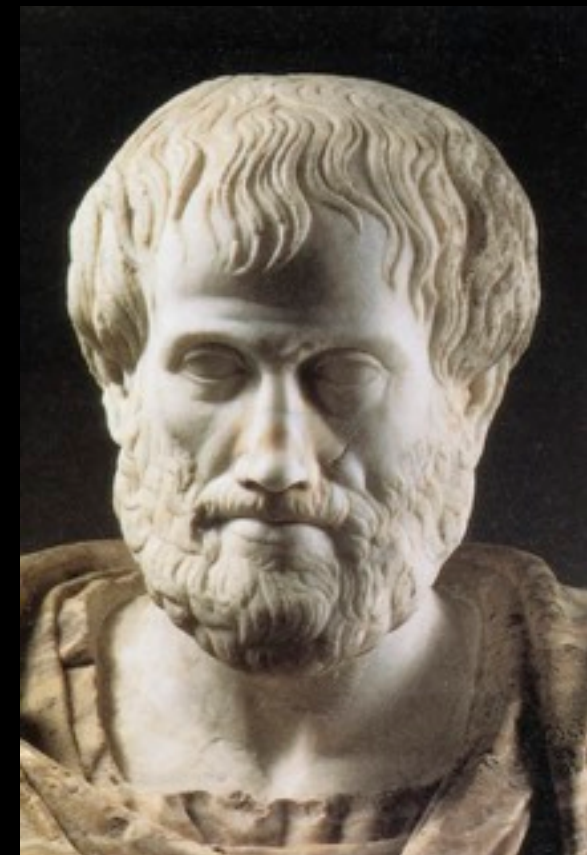
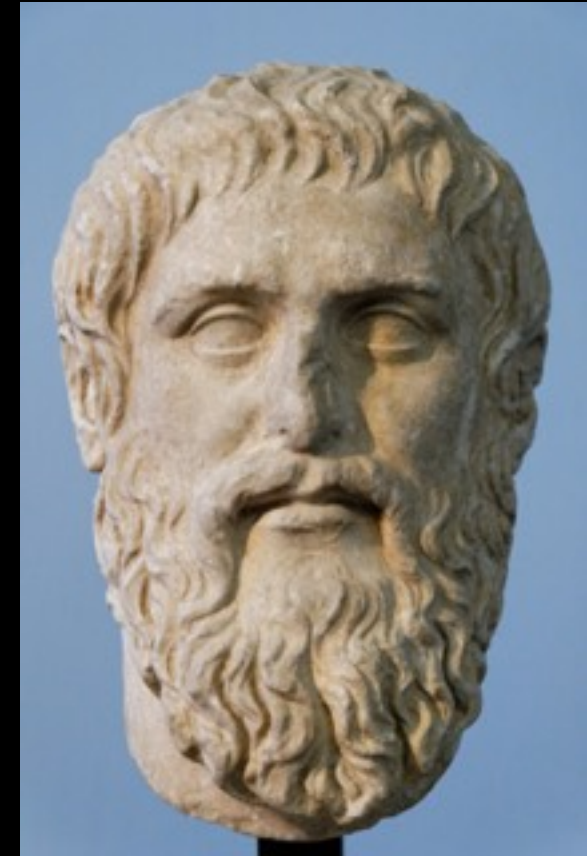
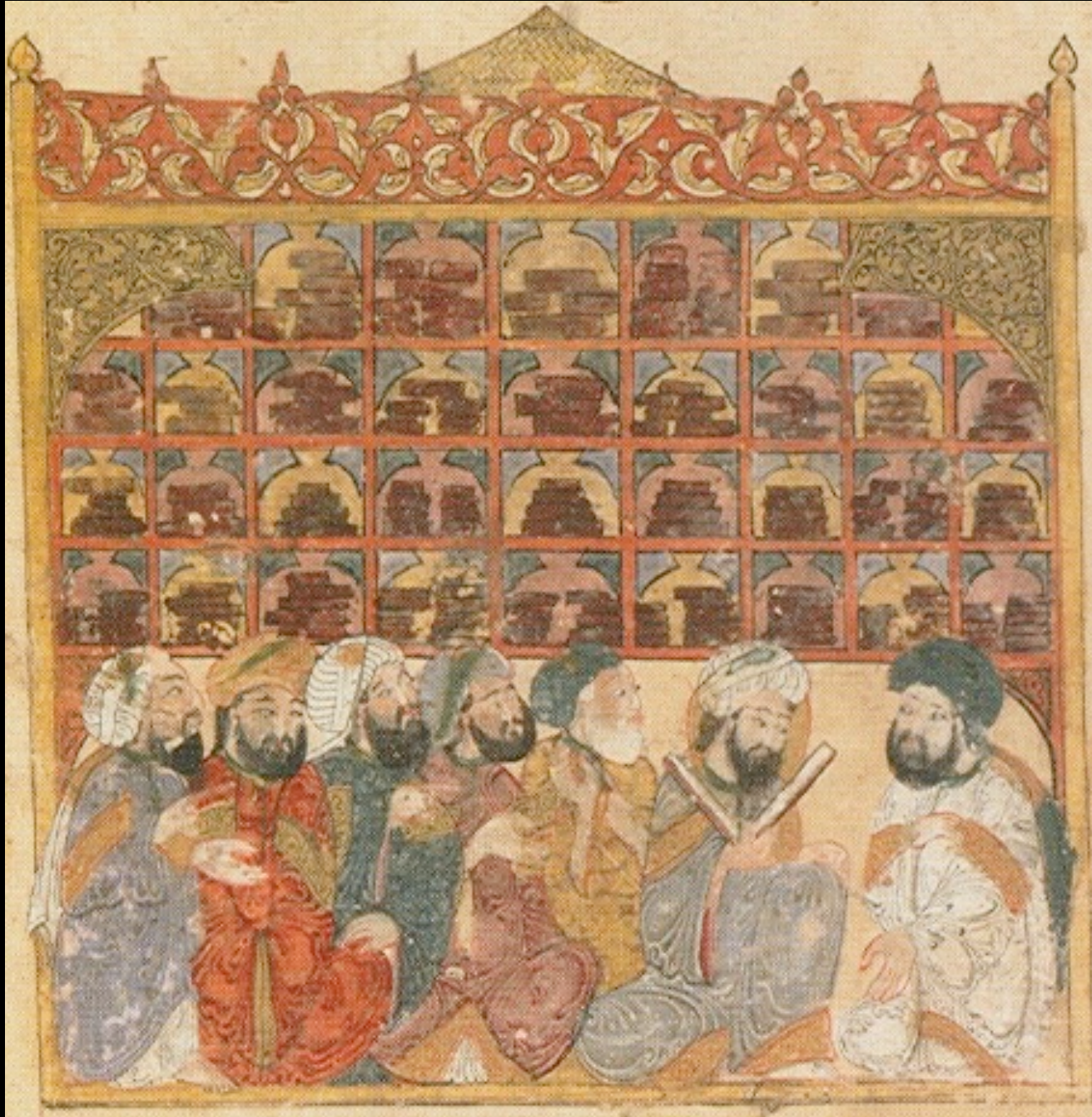
THE GREEKS IN THE EAST: Baghdad 8th Century

Science
and
Islam



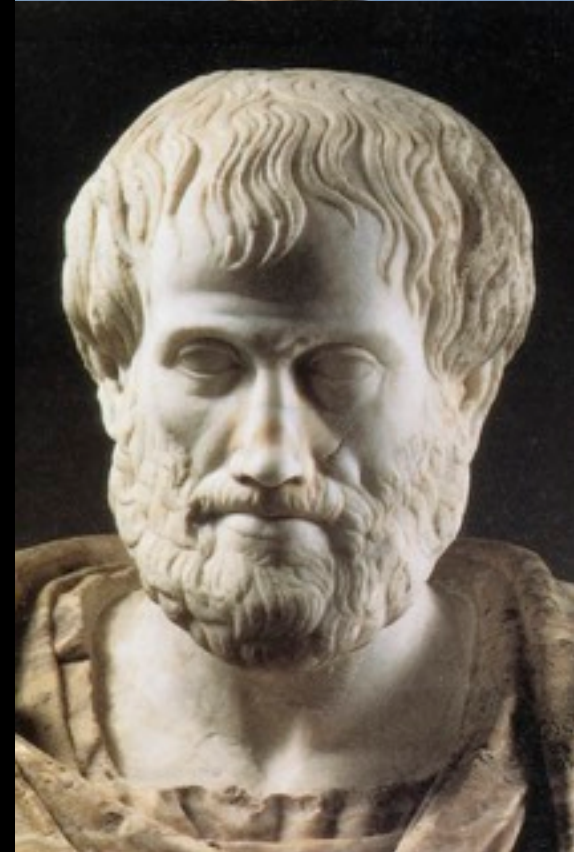
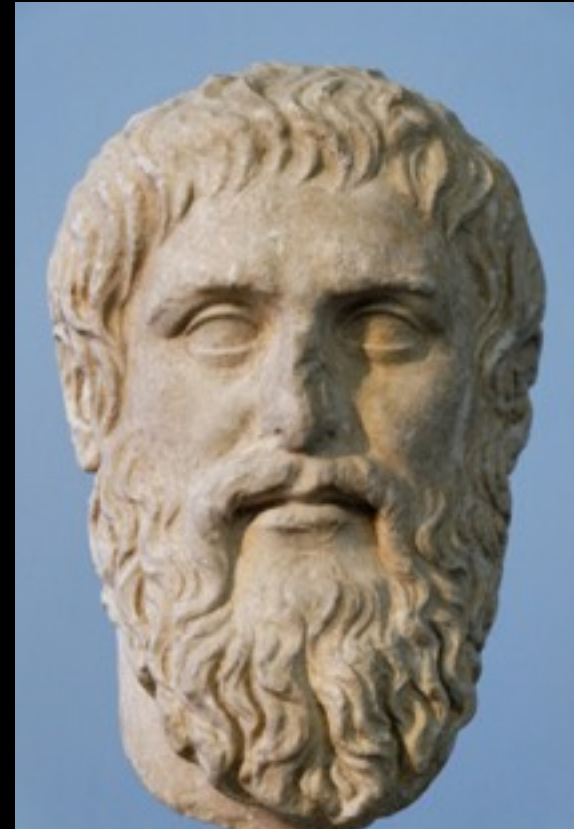
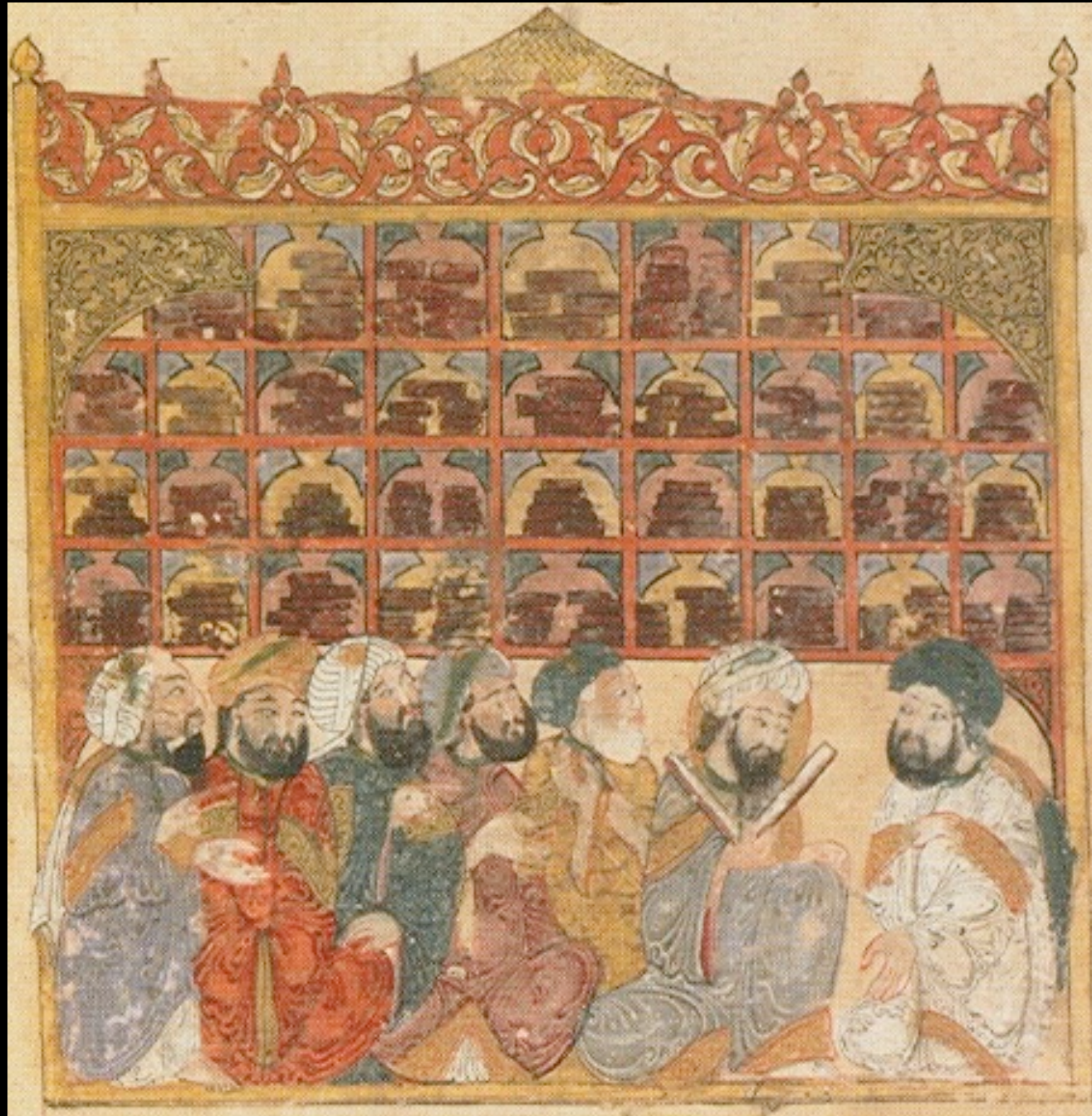
Scholars at the great library of Baghdad
during the “Islamic Golden Age”

Greek philosophical tradition carried to Iran/Iraq by Greek Christians translated to Arabic



Carried to other parts of Islamic empire esp SPAIN

Greek philosophical tradition carried to Iran/Iraq by Greek Christians translated to Arabic



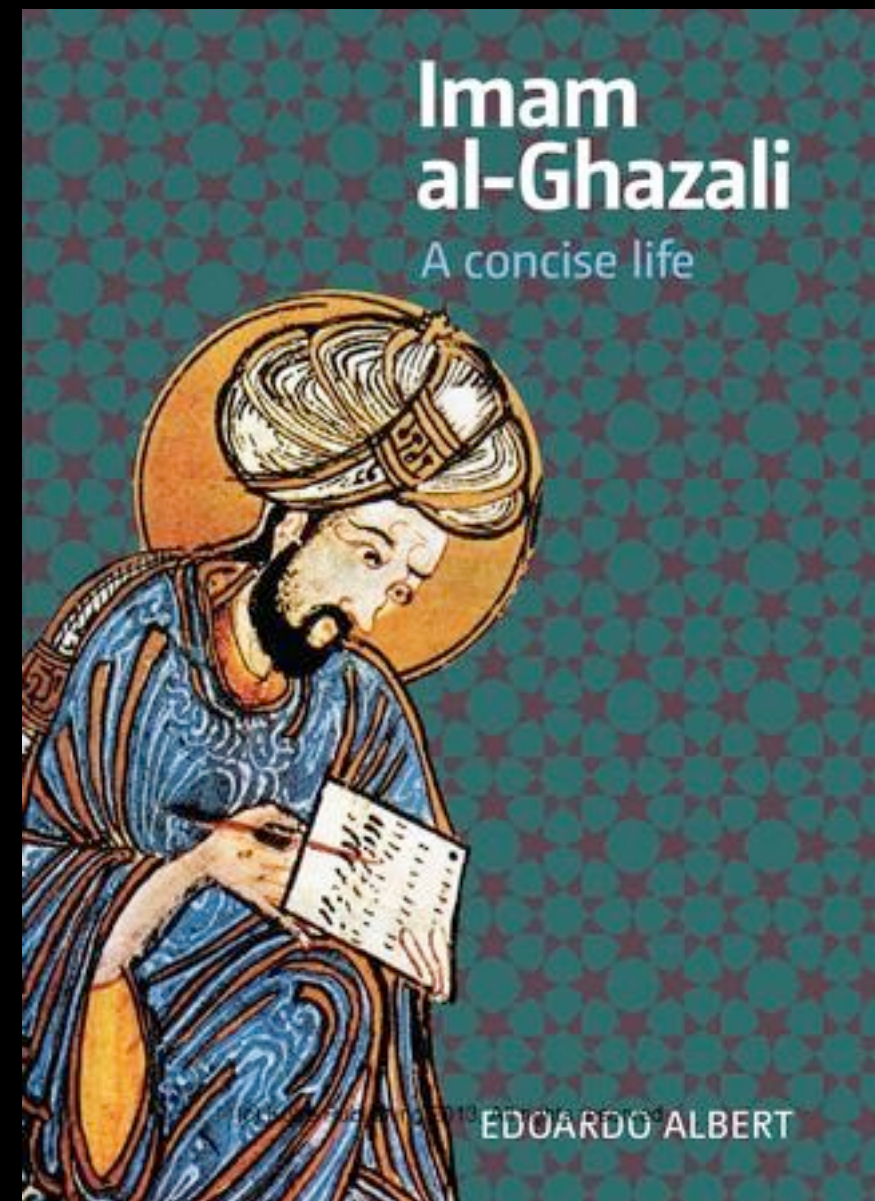
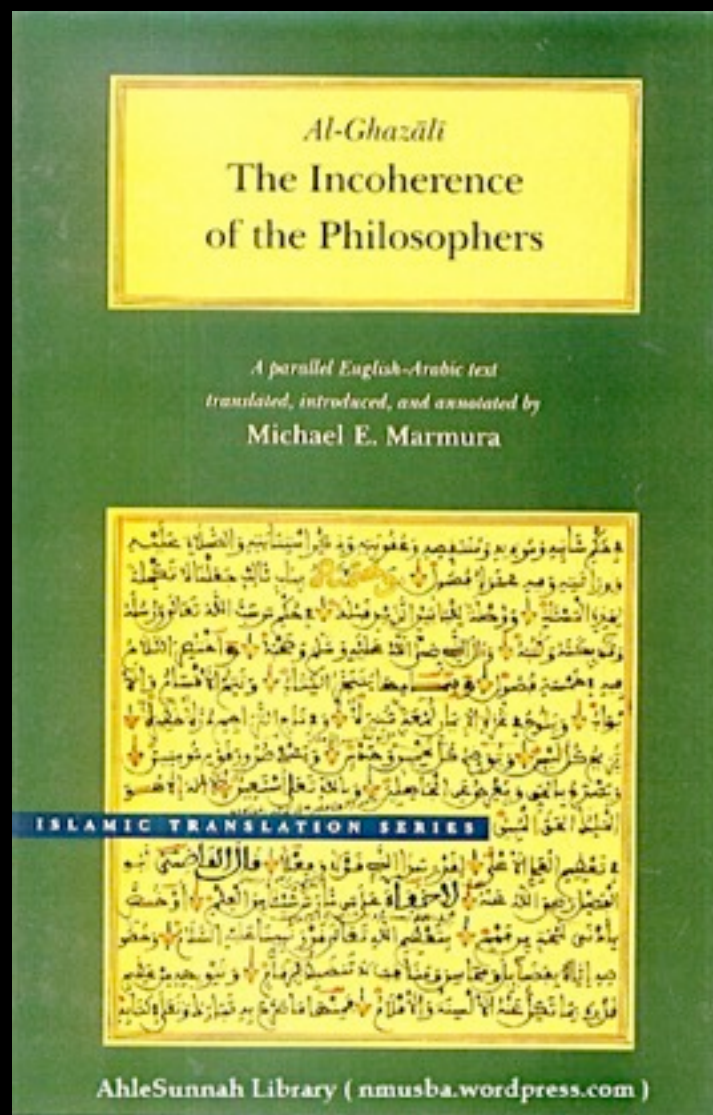
THE
HOUSE
OF
WISDOM

400-1258, Baghdad center of study

The House of Wisdom, Baghdad, c. 1000 AD



1111 Al-Ghazali Shuts Down Study of Greeks: "We dont need them." Shuts down Islamic Independent Sci Tradition Intolerance



1056-1111

The *Incoherence* also marked a turning point in Islamic philosophy in its vehement rejections of Aristotle and Plato.

1100 AD

Influential Islamic clerics began to argue that the study of Greek philosophy was incompatible with the teachings of the Koran.

Indeed, it was blasphemous to suggest that man might be able to discern the divine mode of operation, which God might in any case vary at will. In the words of Al-Ghazali, author of *The Incoherence of the Philosophers*, 'It is rare that someone becomes absorbed in this [foreign] science without renouncing religion and letting go the reins of piety within him.'

Al-Ghazālī
The Incoherence
of the Philosophers

A parallel English-Arabic text
translated, introduced, and annotated by
Michael E. Marmura



AhleSunnah Library (nmusba.wordpress.com)

Al-Ghazālī
The Incoherence
of the Philosophers

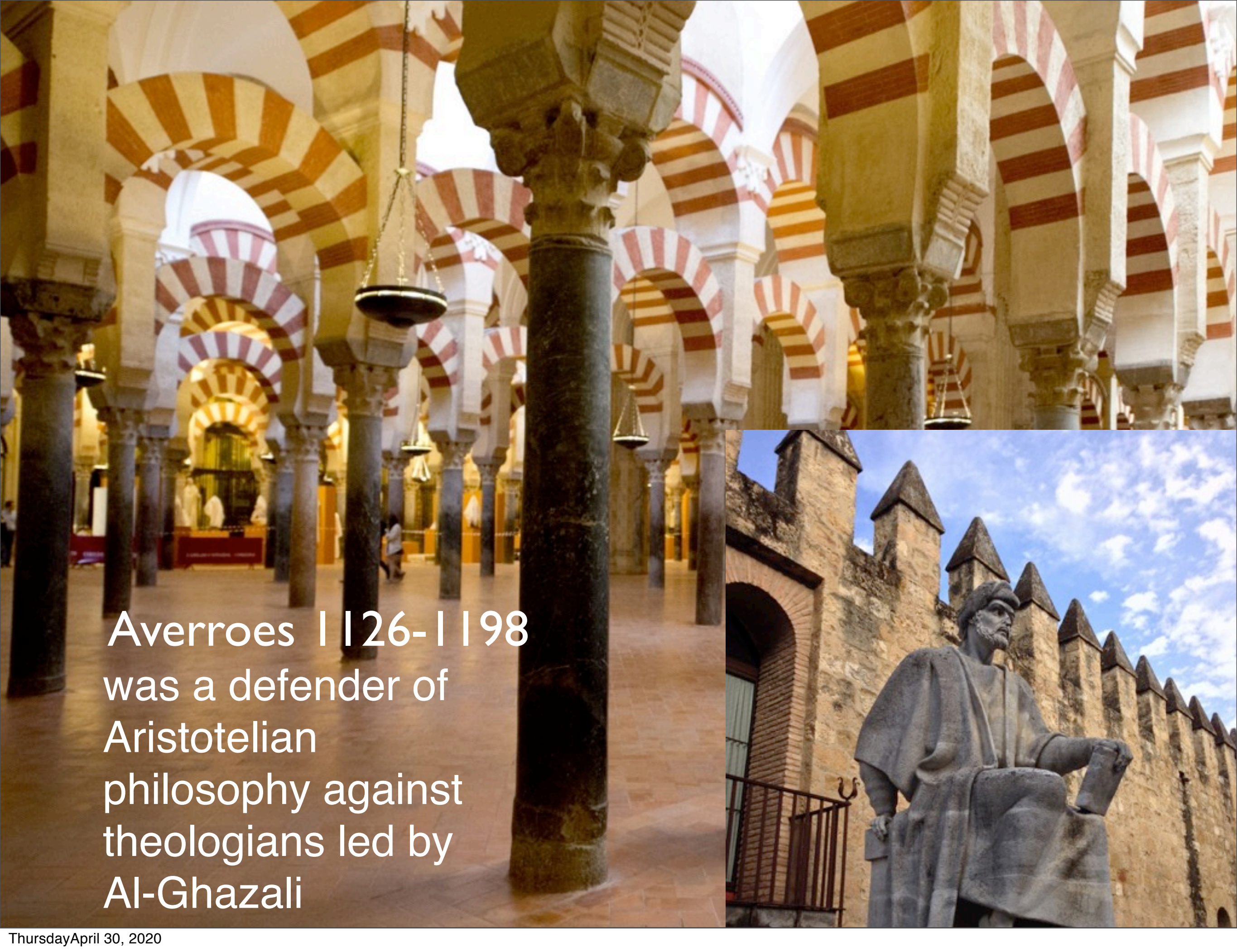
A parallel English-Arabic text
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AhleSunnah Library (nmusba.wordpress.com)

Under clerical influence, the study of ancient philosophy was curtailed, books burned and so-called freethinkers persecuted; increasingly, the madrasas became focused exclusively on theology at a time when European universities were broadening the scope of their scholarship.

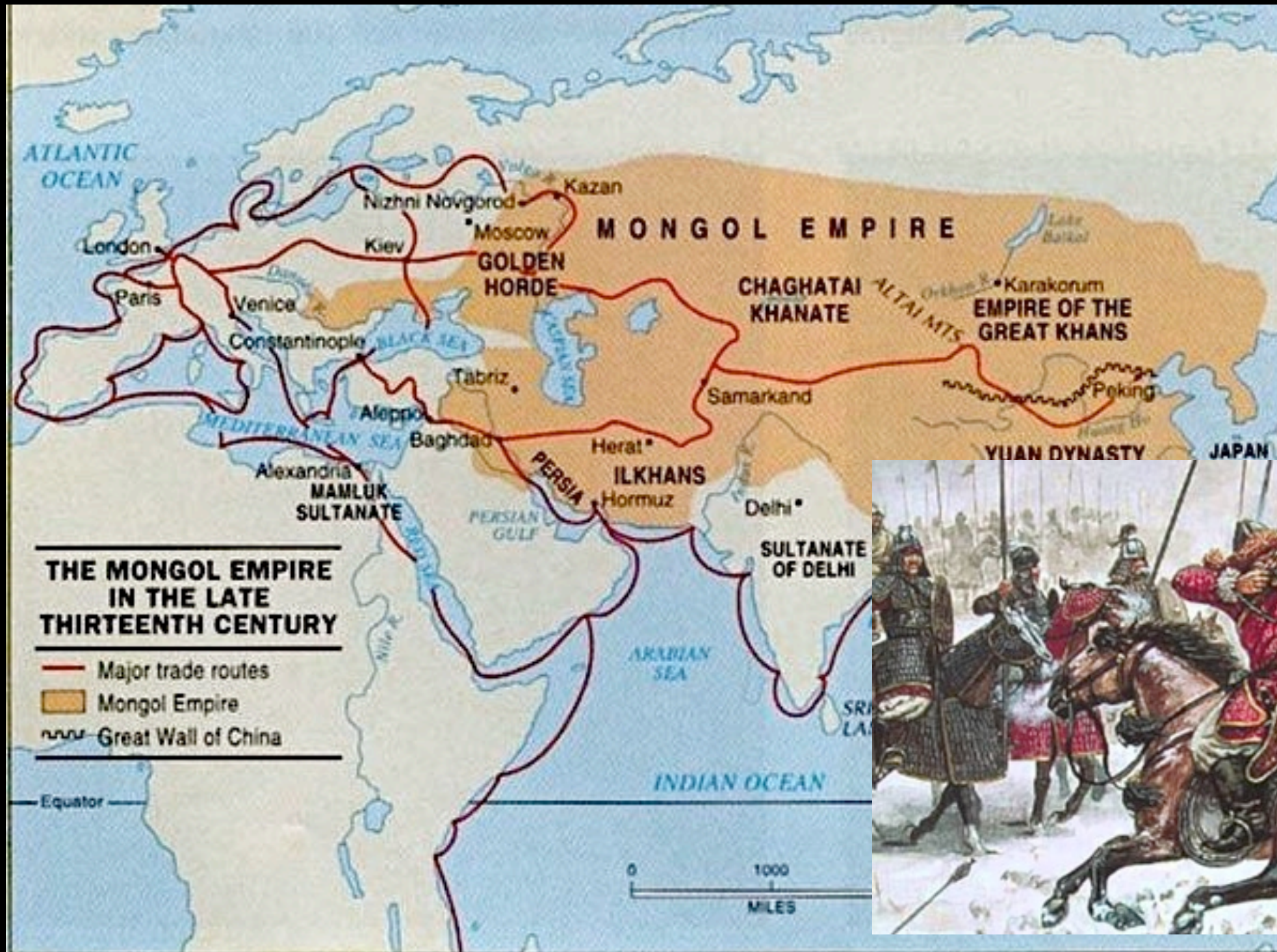
Averroes was driven out of Cordoba and his books burned. (1100s)

The image is a composite. The left side shows the interior of the Great Mosque of Cordoba, featuring a series of double arches with red and white stripes, supported by dark columns. The right side shows a statue of Averroes, a bearded man in a turban and robe, standing in front of a stone wall with crenellations under a blue sky with clouds.

Averroes 1126-1198
was a defender of
Aristotelian
philosophy against
theologians led by
Al-Ghazali



Mongol conquest and destruction of Baghdad 1258



The Mongols extended their hegemony over a major part of the Eurasian landmass, from the Danube to the Pacific for the better part of two centuries.

Marco Polo visits Mongol ruled Beijing c. 1300

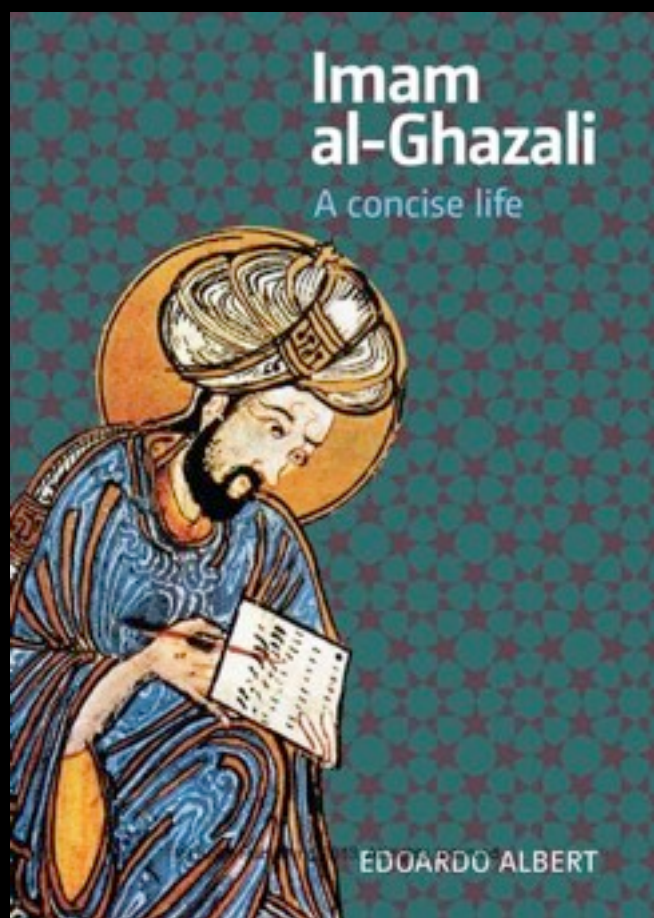
1258: Mongols Destroy Baghdad (library, books)



1000-1100

Islamic East turns away from Greek philosophy-science.

Christian Europe begins long march back to recoup
Greek science, first using Latin, then in 1400
re-acquiring Greek in Florence.



In the West, the long journey from 1000-Renaissance When Greek brought back to West: Florence



Bologna



University of Bologna

Thursday April 30, 2020





In the twentieth century, Sir **William Dampier** spoke for most conventional academics when he complained that scientific thought was “quite foreign to the prevailing mental outlook” of the Scholastics, (Medieval philosophers) who were enmeshed in a “tangle of astrology, alchemy, magic and theosophy” Absolutely hostile to experimentalism. (totally ridiculous quotation)





Historian **R. W. Southern**:
“Regarded simply as an effort to comprehend the structure of the universe and ... to demonstrate the dignity of the human mind by showing that it can know all things,—this body of medieval thought is one of the most ambitious displays of Scientific Humanism ever attempted.”

Given this commitment to the pursuit of knowledge, Christian theology and natural philosophy were closely linked during medieval times.

As the distinguished historian **Edward Grant** noted, “Within Western Christianity in the late Middle Ages ... almost all professional theologians were also natural philosophers. The structure of medieval university education also made it likely that most theologians had early in their careers actually taught natural philosophy.”





MEDIEVAL
UNIVERSITY
EDUCATION
(1000)
IS A
CONTINUATION
OF
CLASSICAL
EDUCATION
IN LATIN

Cassiodorus

Institutions of Divine and
Secular Learning
On the Soul

Translated by James W. Halporn with an
introduction by Mark Vessey



LIVERPOOL
UNIVERSITY
PRESS



Cassiodorus' Institutes, 585 AD



Univ of Bologna 1000

MEDIEVAL
UNIVERSITY
EDUCATION
(1000)
IS A
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OF
CLASSICAL
EDUCATION
IN LATIN

Age of Dante: 1265-1321, Polo to China,
Mondino dissections, Grossteste sci experiment,
Sacrobosco math, Roger Bacon scientist



QUI COELUM CLONIT MEDIVM QVE LVNIVM QVE TRIBVNAL LVSTRAVIT QVE ANIMO CVNCTA POETA SVO DOCTVS ADEST DANTES SVA QVEM FLORENTIA SAEPE
SENSIT CONSILIVS AC PIETATE PATRE NIL POTVIT TANTO MORIS SALVA NOCERE POETAE QVEM VIVVM VIRTVS CARMEN IMAGO FACIT



Mondino de Luzzi
(1270-1326)

1315

Mondino de' Luzzi
(1270– 1326) wrote a
textbook on dissection,
based on his study of two
female cadavers.

**1315, he performed a
human dissection in
front of an audience
of students and faculty at
the University of Bologna.**
Dissection not allowed in

Ancient Greece

Not allowed in China

Not allowed in Islam



Most important contribution involved what has come to be called the scientific method. One of these contributions was what he called the principle of “resolution and composition”— which involved reasoning from the particular case to the general and then back again. For example, by looking at a particular case, one can formulate a universal law about nature and then apply this law to make predictions about all the other relevant cases— such as by formulating a law about eclipses of the moon and then testing that law by applying it to eclipses of the sun. Note the **emphasis on observation as the basis of all science.**

Grosseteste’s commitment to empiricism was such that he introduced the notion of the controlled scientific experiment to Western thought. The fundamental principle is that, as one historian of science summarized, “when one controls his observations by eliminating any other possible cause of the effect, he may arrive at an experimental universal of provisional truth.”

Robert Grossteste (1175-1253)

University of Paris 1220's

Two influential books,
both of which survive.

The first was
Algorismus, which
introduced Hindu-
Arabic numerals and
new methods of
numerical calculation
for the first time to the
European universities.



John of Sacrobosco
(1195-1256)



University of Paris 1220's

His second,
 Tractatus de Sphaera (usually
 referred to as Sphere),
 was a readable astronomy
 textbook based on Ptolemy's
 cosmology.

The title reflects the claim that the
 earth and all the heavenly bodies
 are spherical. Sphere was required
 reading for European university
 students for the next several
 centuries, often praised for its
 clarity

John of Sacrobosco
 England (1195-1256)



THOMAS AQUINAS

SUMMA THEOLOGICA

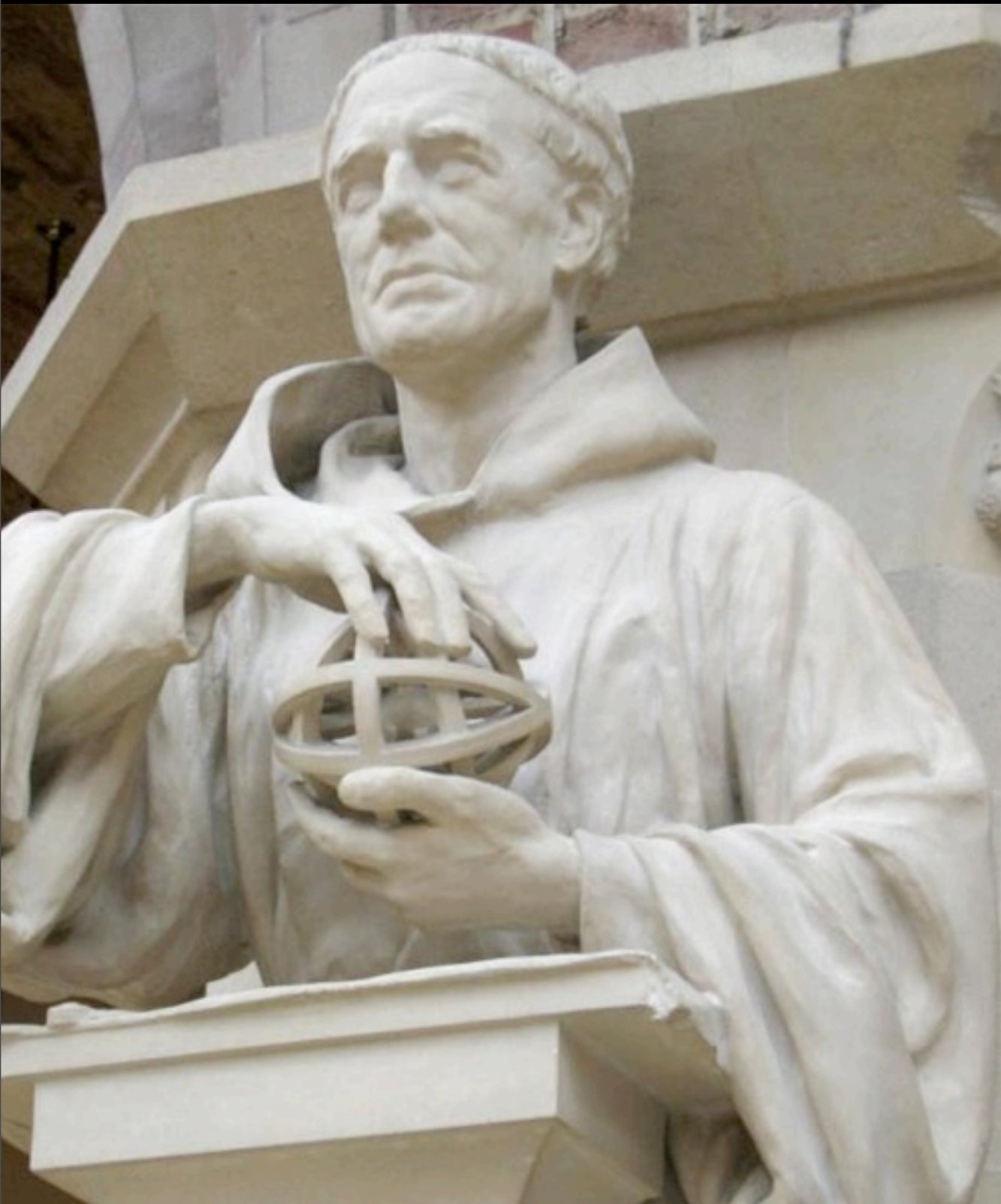
1274

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xi

He was the foremost medieval proponent of "natural theology" and the father of Thomism; of which he argued that reason is found in God. His influence on Western thought is considerable, and much of modern philosophy developed or opposed his ideas, particularly in the areas of ethics, natural law, metaphysics, and political theory. Thomas embraced several ideas put forward by Aristotle — whom he called "the Philosopher" — and attempted to synthesize Aristotelian philosophy with the principles of Christianity.



**Roger Bacon (Oxford)
(1214-1294)**

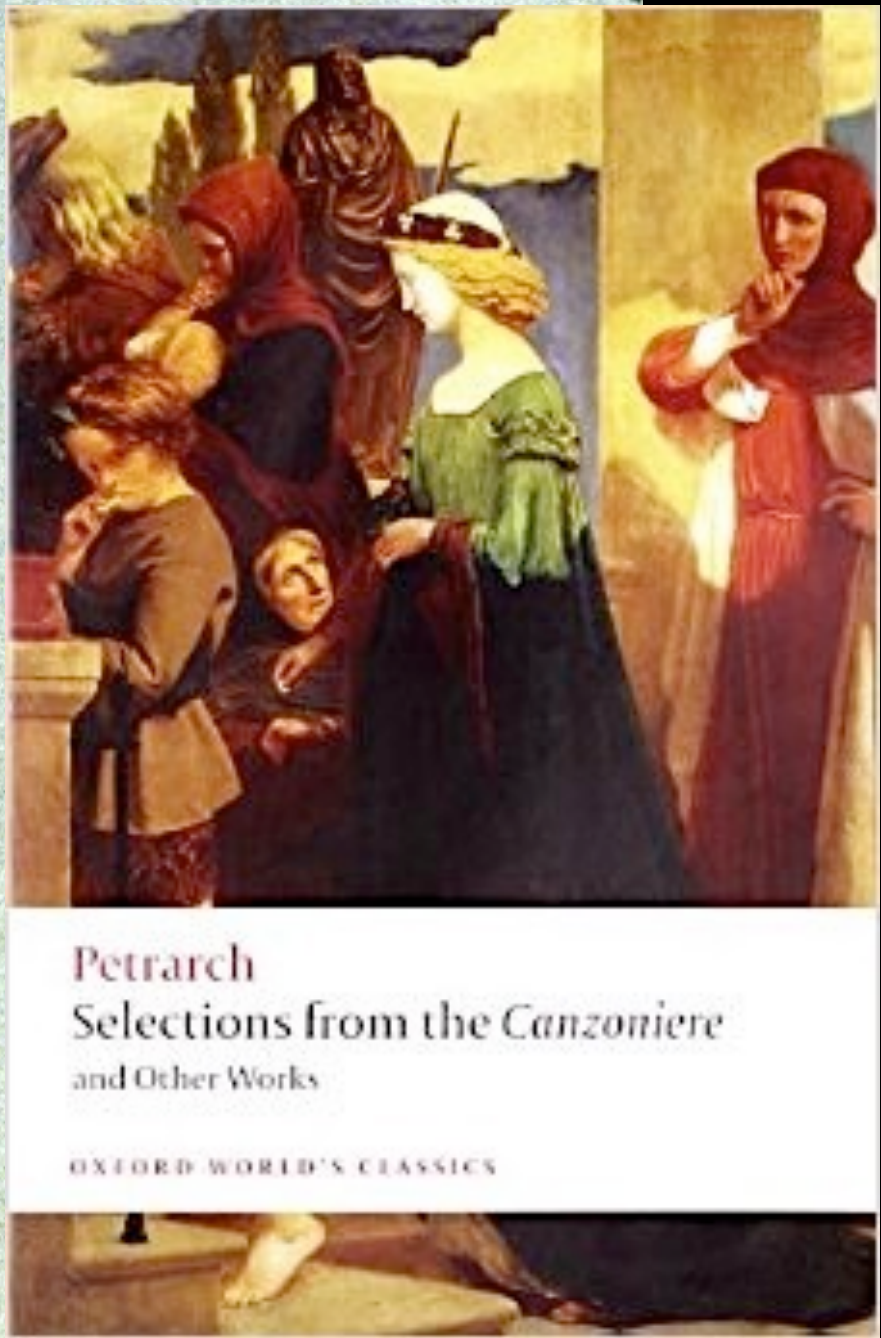
The first Medieval scientist,
in that he fully embraced
Grosseteste's commitment
to the experimental method
Opus Majus.

Written in only a year of frantic
effort, the available modern edition
runs to 1,996 pages. In it, Bacon
displayed knowledge of many
different fields : mathematics; the
size and position of heavenly
bodies; the physiology of eyesight,
optics, including refraction, mirrors
and lenses, the magnifying glass,
and spectacles; an accurate recipe
for gunpowder; calendar reform; .



1. Science in the Ancient World: Greece
Science in the Ancient World: Israel
2. Science in the Middle Ages
3. Science in the Ren-Ref
4. Science and Time
5. Science in the Seventeenth Century





Francesco Petrarca, 1304-1374



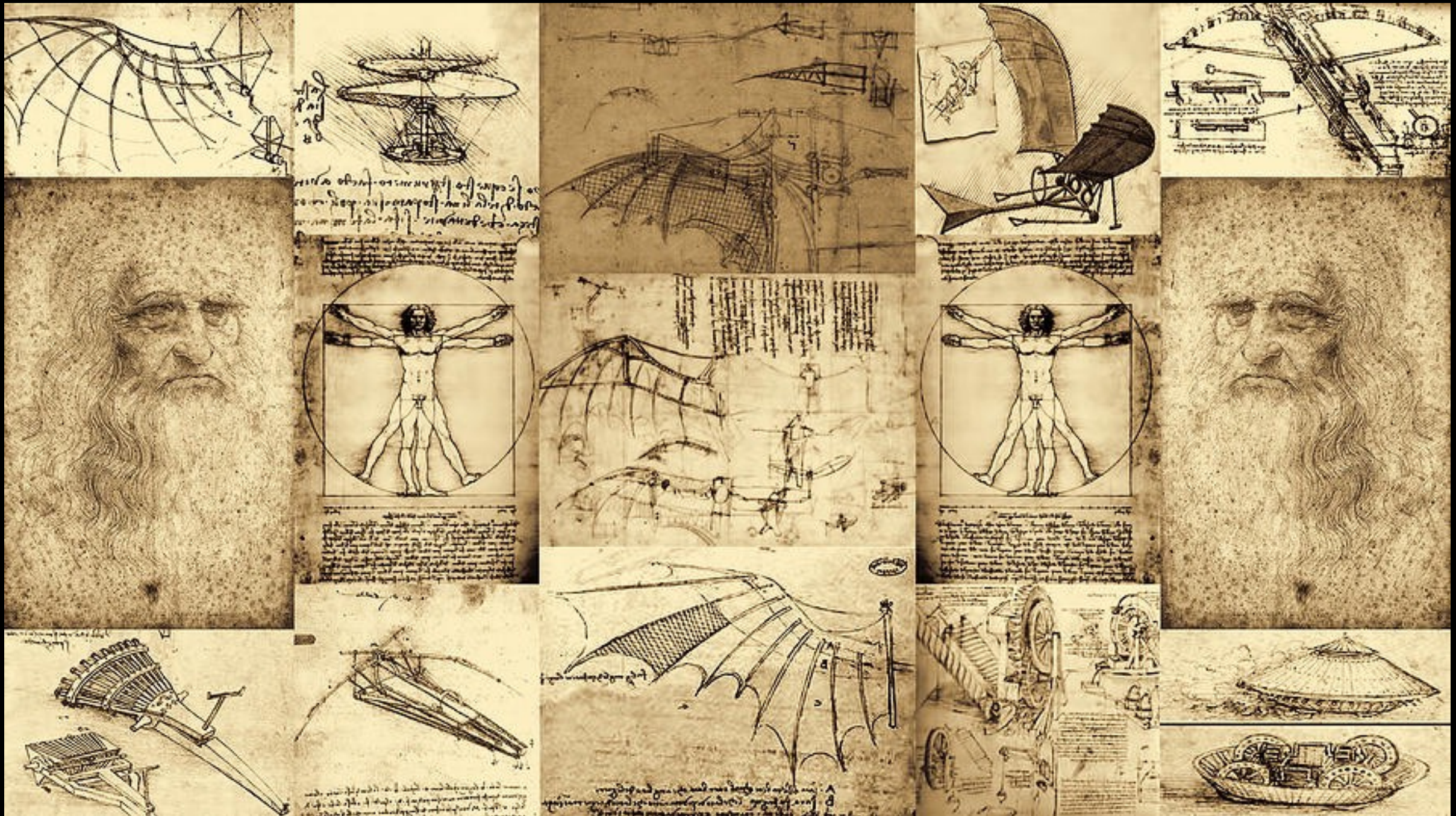
SCHOLARSHIP

Petrarch in the Library in Verona, 1345, Find Cicero

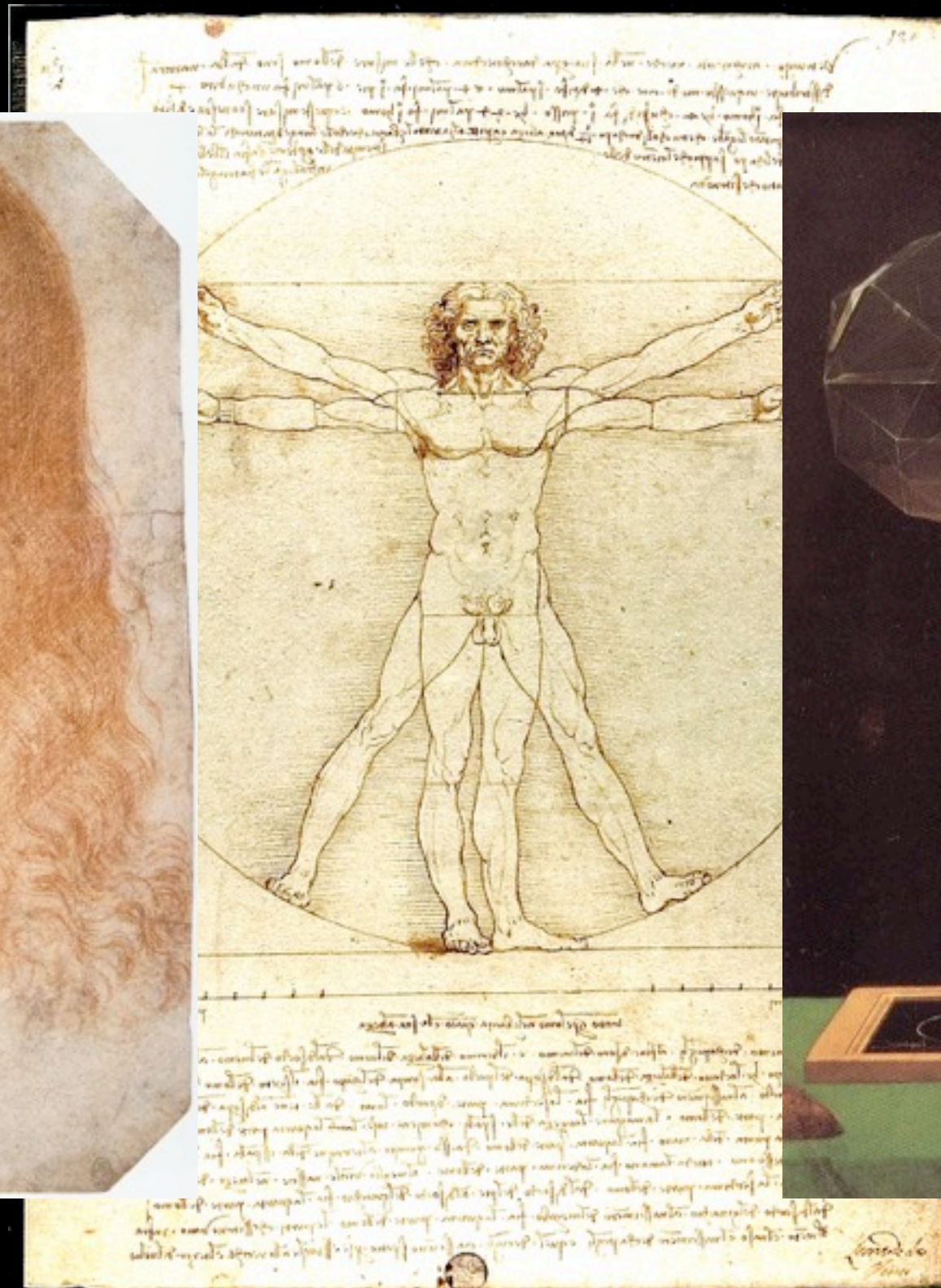


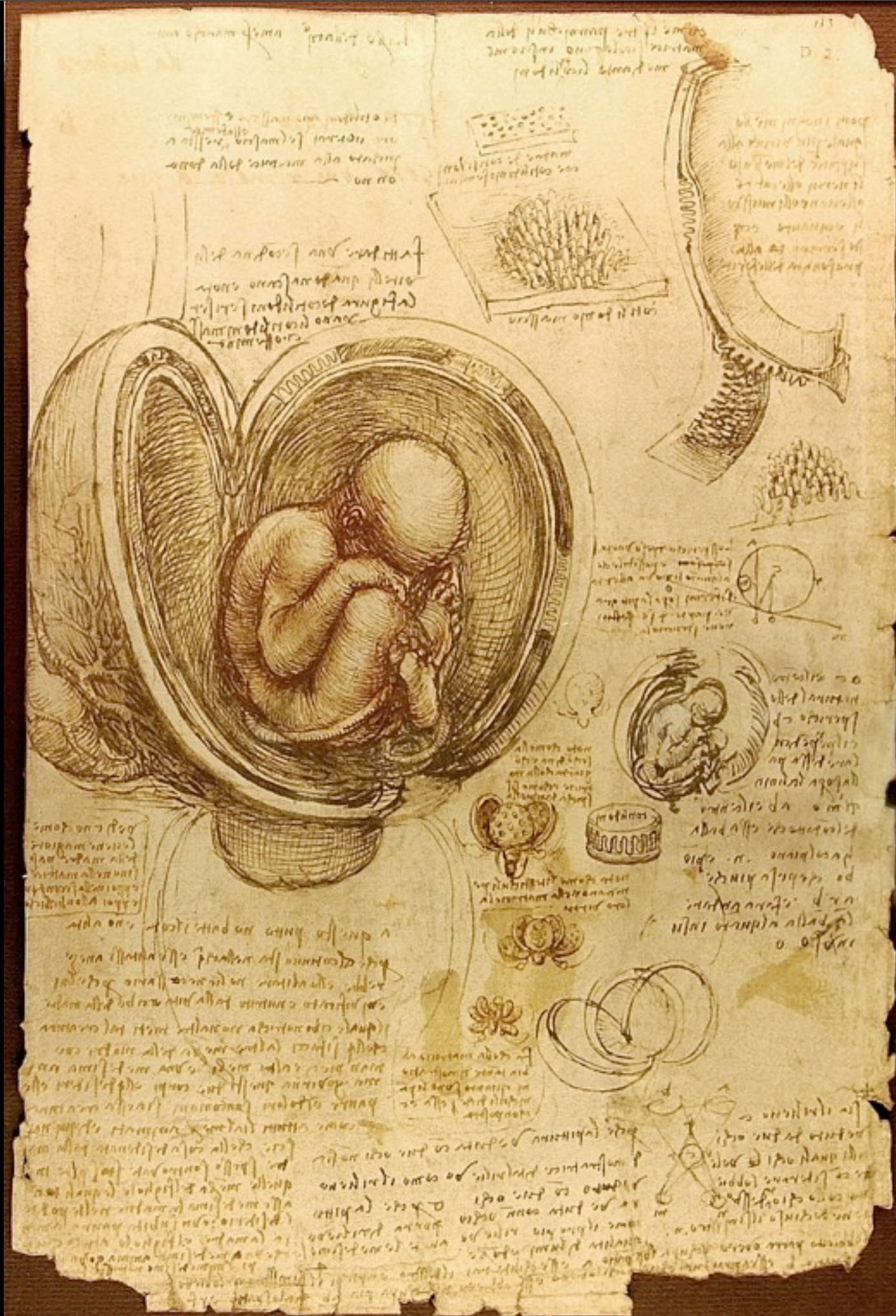
I 400 GREEK COMES TO FLORENCE
Now Greek Mss. can be rescued
Brought to European libraries

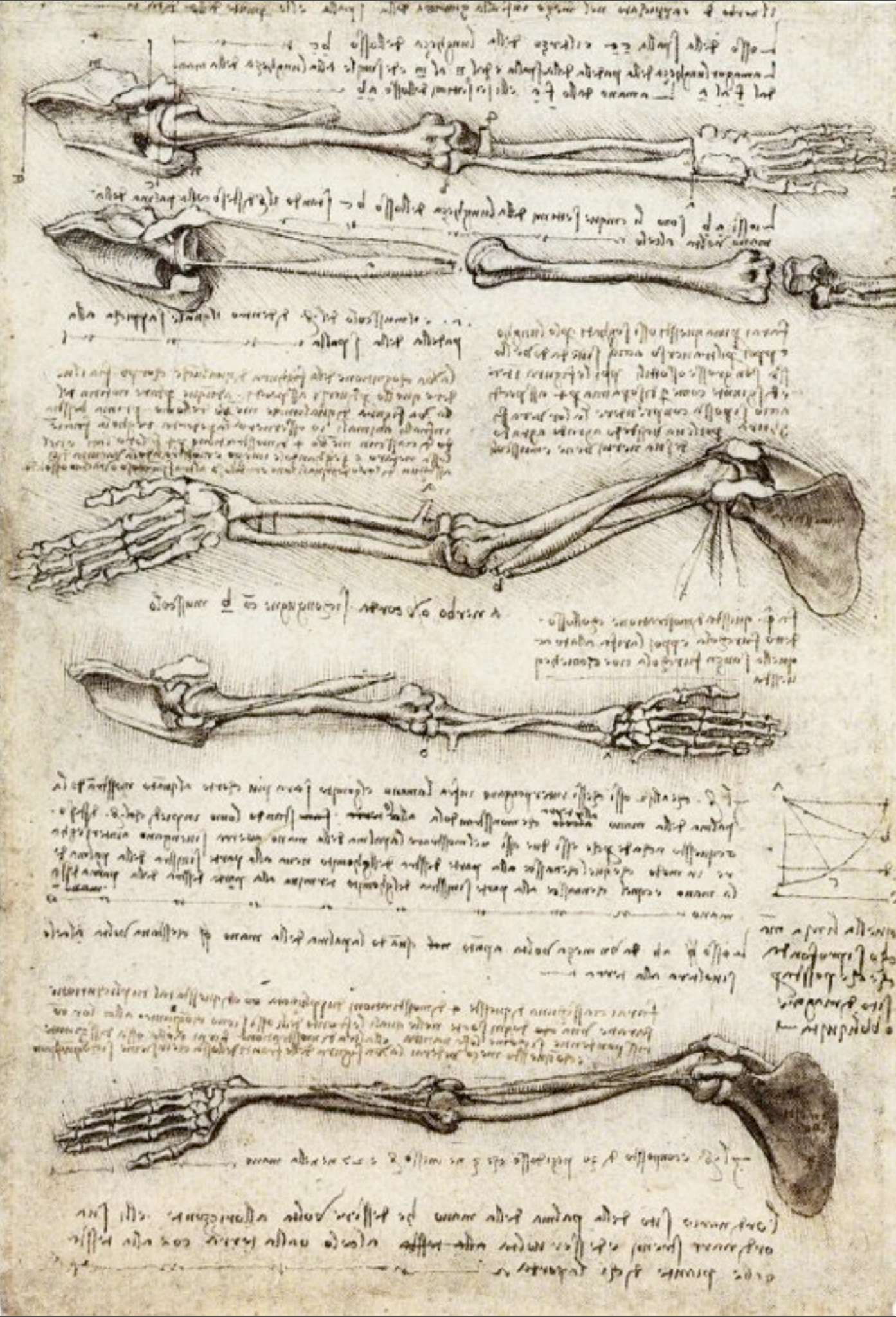
I 500 Leonardo da Vinci

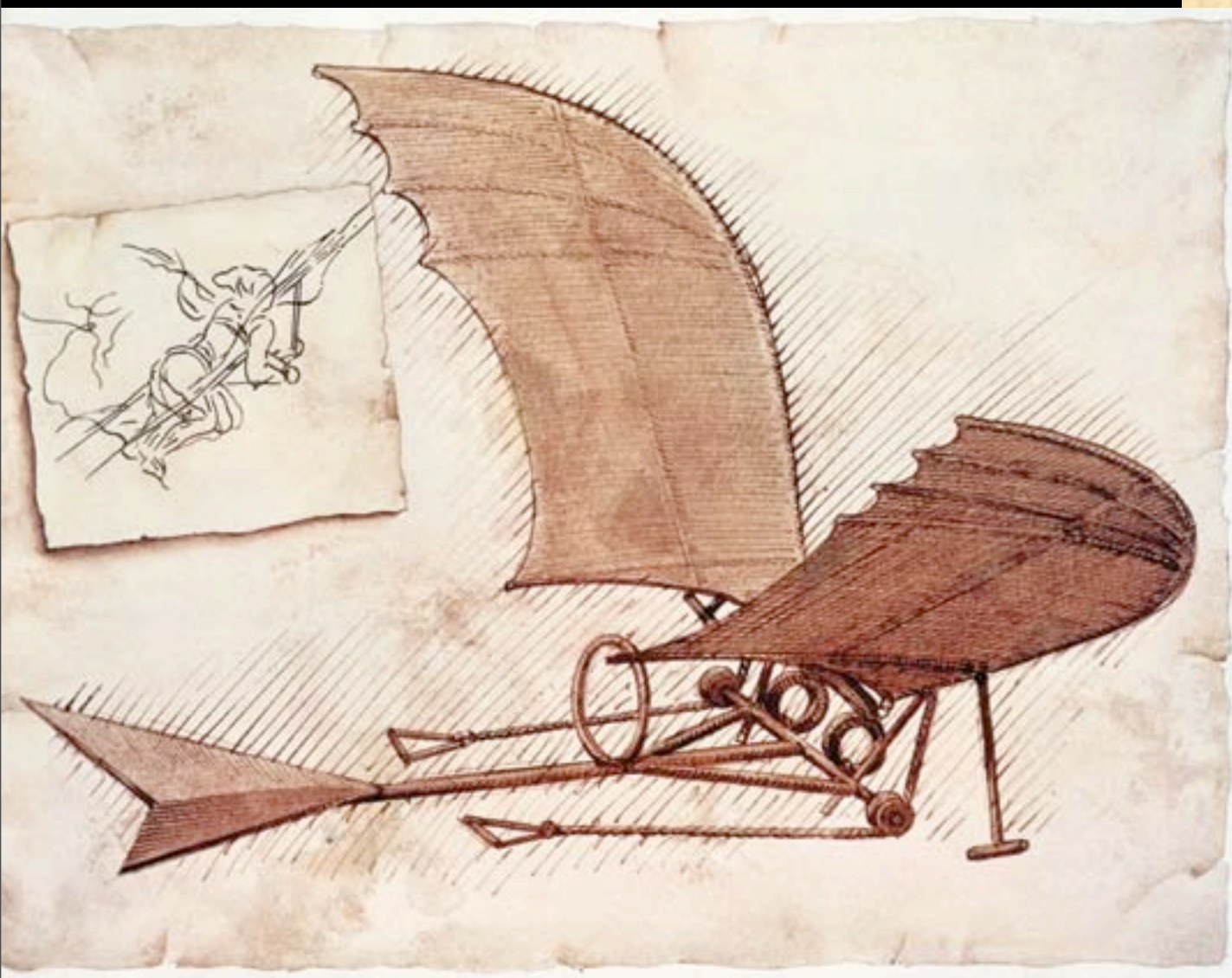
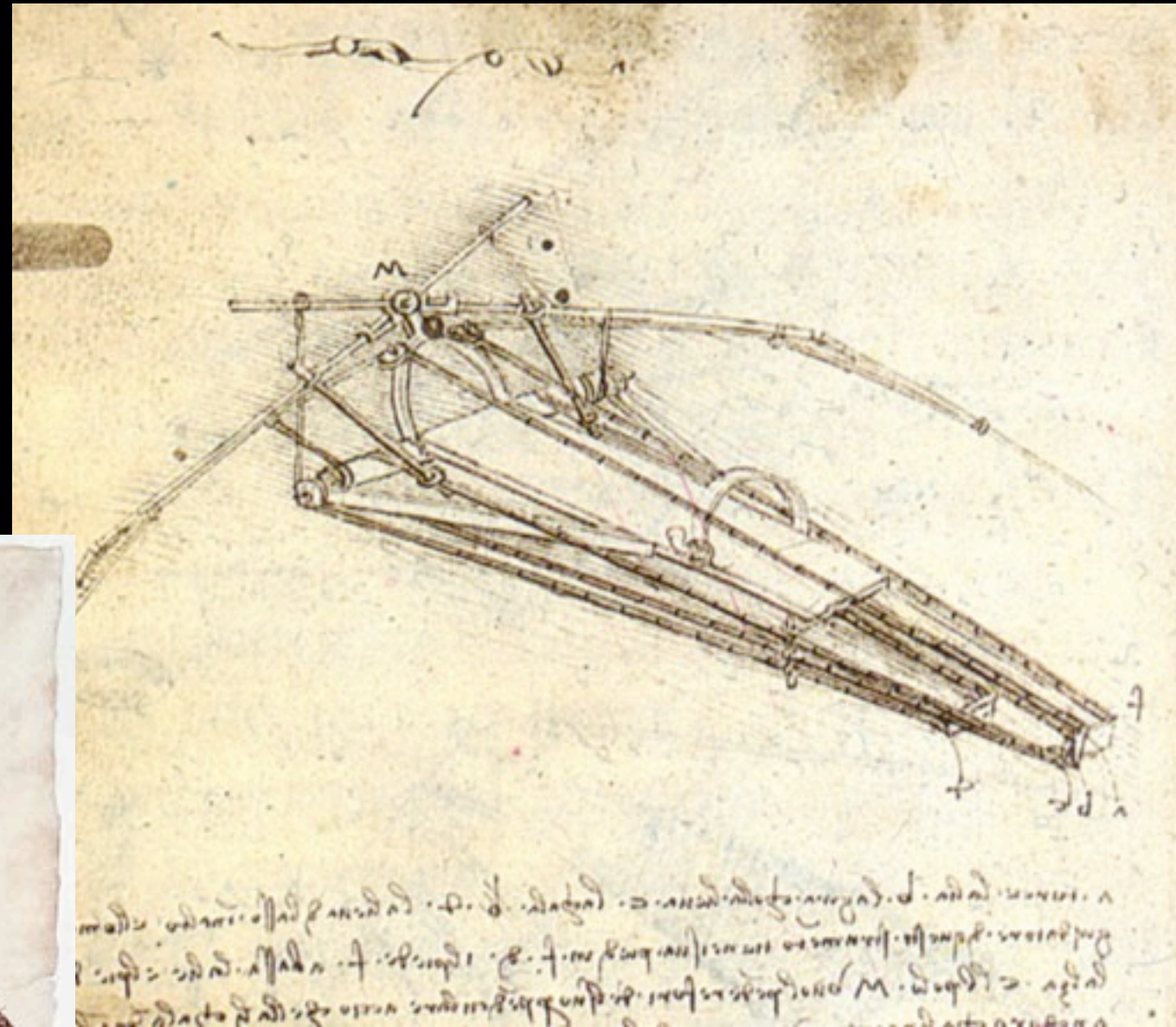
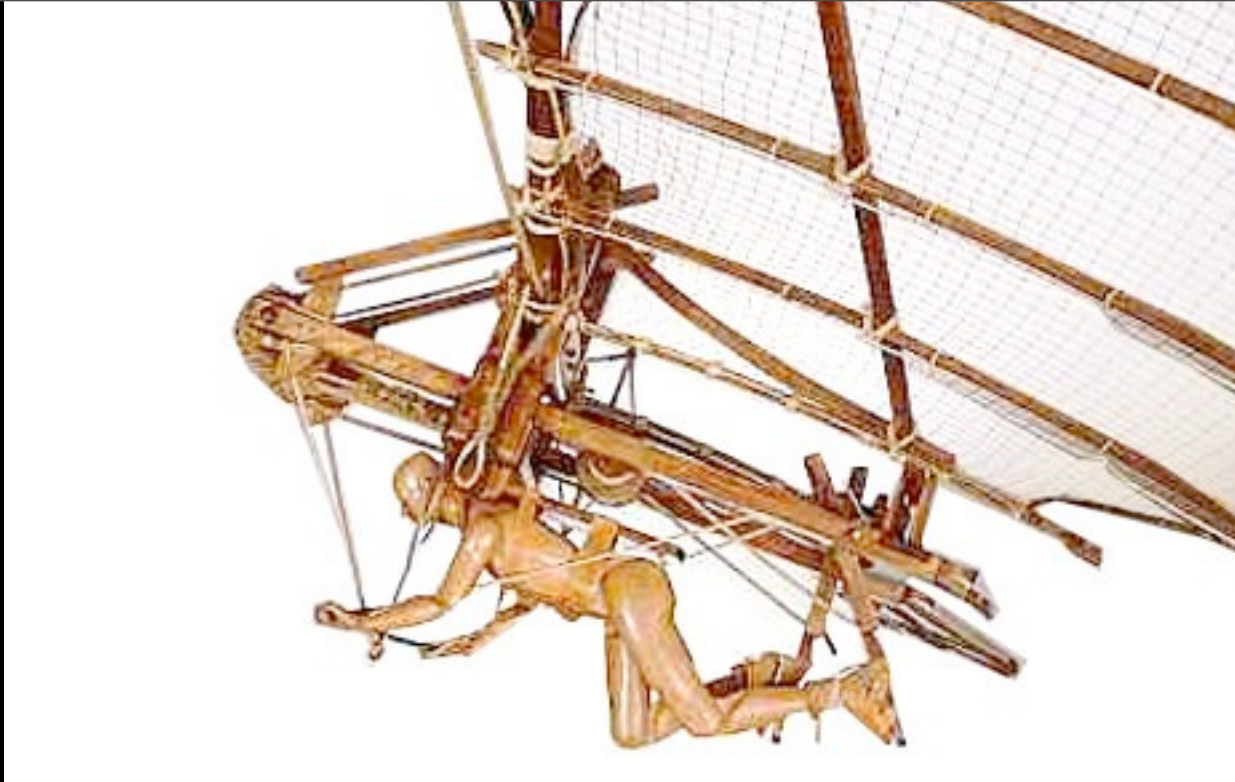


The Renaissance and Leonardo da Vinci

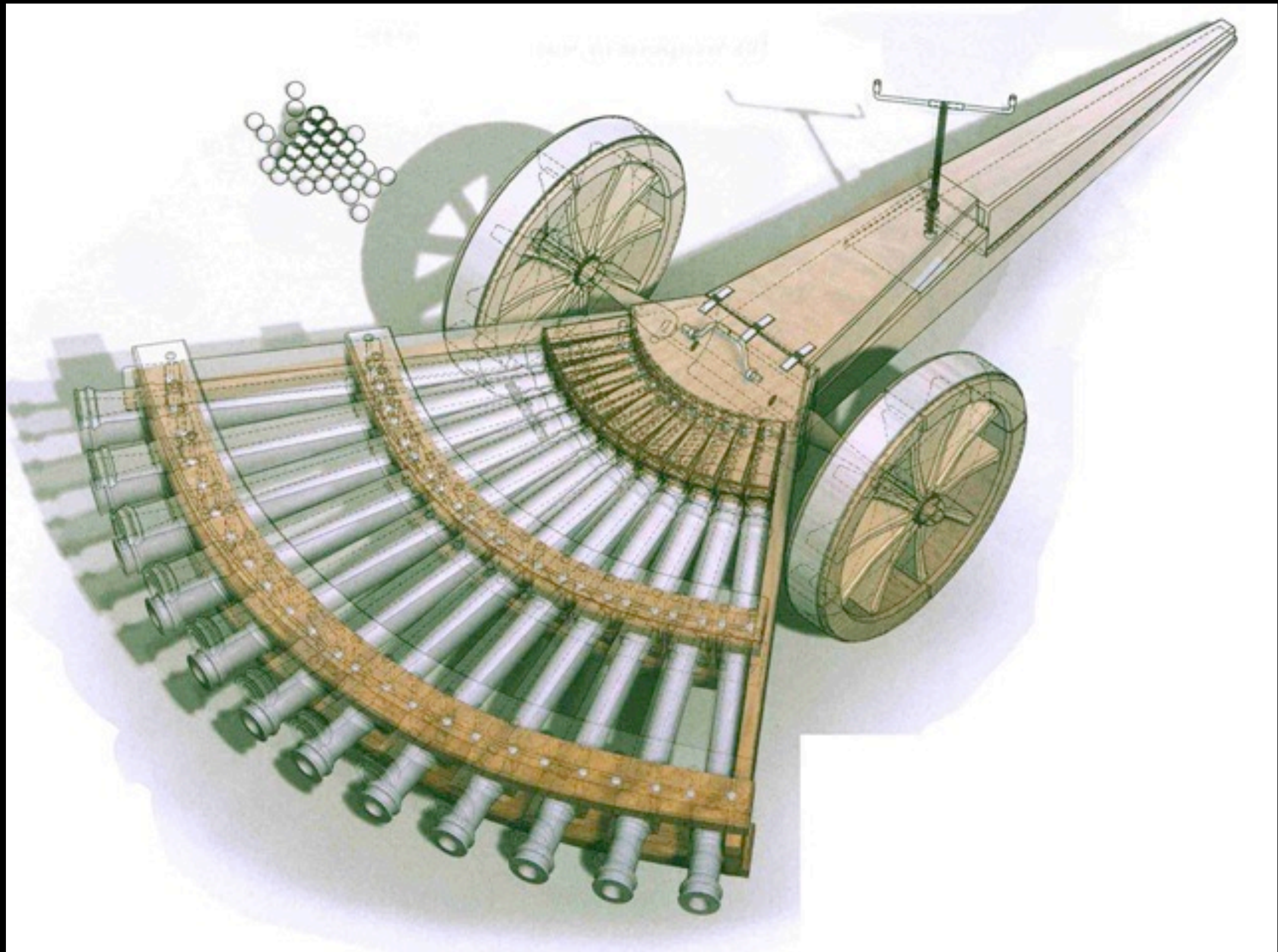




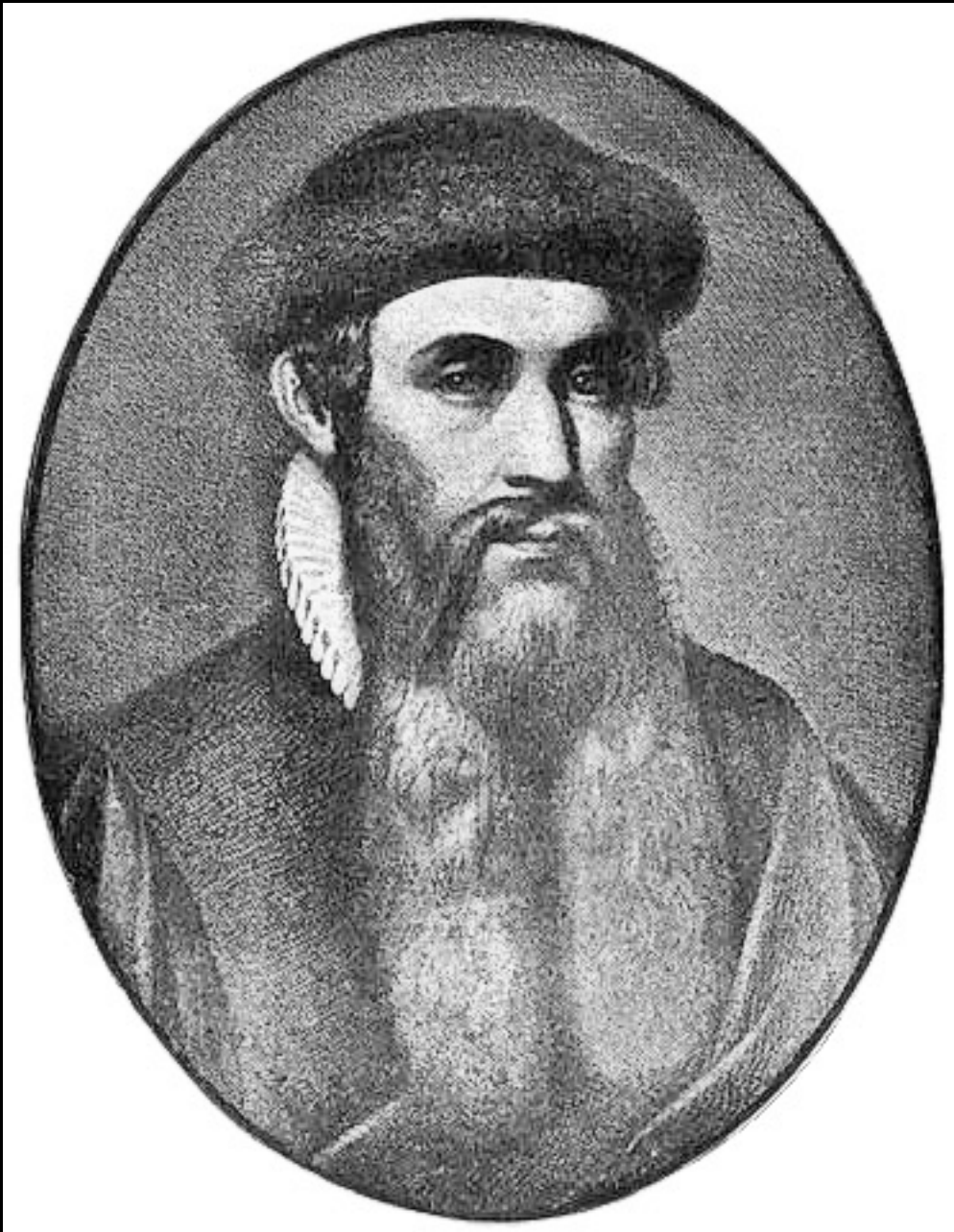




designs for a flying machine



THE PRINTING REVOLUTION 1450-1500



Johannes Gutenberg
(1398-1468)

German blacksmith, goldsmith, printer, and publisher who introduced printing to Europe. His invention of mechanical movable type printing started the Printing Revolution and is widely regarded as the most important event of the modern period. It played a key role in the development of the Renaissance, Reformation, the Age of Enlightenment, and the Scientific revolution.

PRINTING ESSENTIAL TO MODERN SCIENCE



Gutenberg 1440-1450



Strasbourg 1440

Cologne 1464

Basel 1466

Rome 1467

Venice 1469

Florence 1471

Milan 1471

Naples 1471

Augsburg 1472

Lyon 1473

Krakow 1474

Bruges 1474

Westminster 1476

Geneva 1478

London 1480

Antwerp 1481

Stockholm 1485

1500

200 printers
in Germany

1518

150 Books
published
in German

THE REFORMATION AND SCIENCE

freedom of speech
freedom of print
freedom of conscience



Oct 31, 1517
Luther Posts
the
Ninety-Five
Theses



Oct 31, 1517
Luther Posts
the
Ninety-Five
Theses



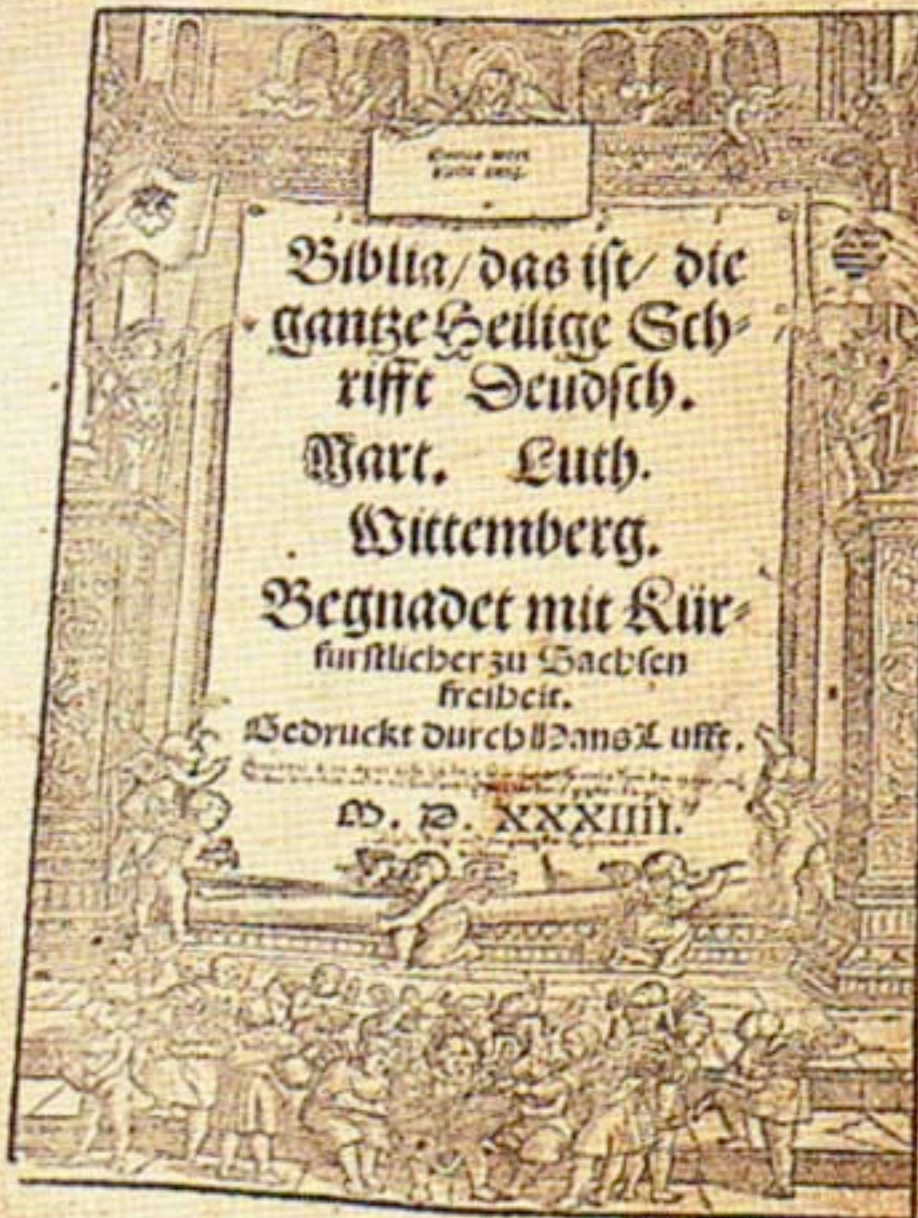
Diet of Worms April 1521 Holy Roman Emperor Charles V vs Professor Martin Luther



Luther in Hiding in the Wartburg Palace
Translating the Bible into German



1870. P. 2 - WARTBURG LUTHERAN CHURCH

[illegible]

THE REFORMATION AND SCIENCE

The REFORMATION
and
SCIENCE
freedom of speech
freedom of print
freedom of conscience

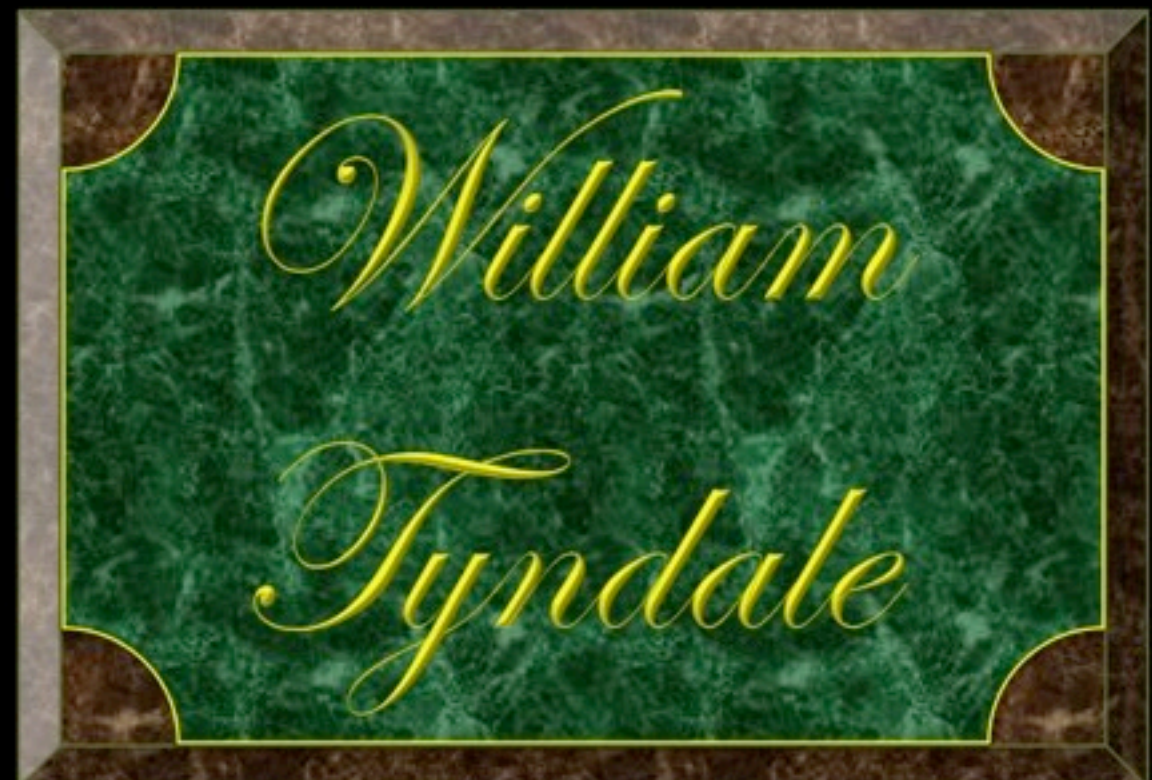
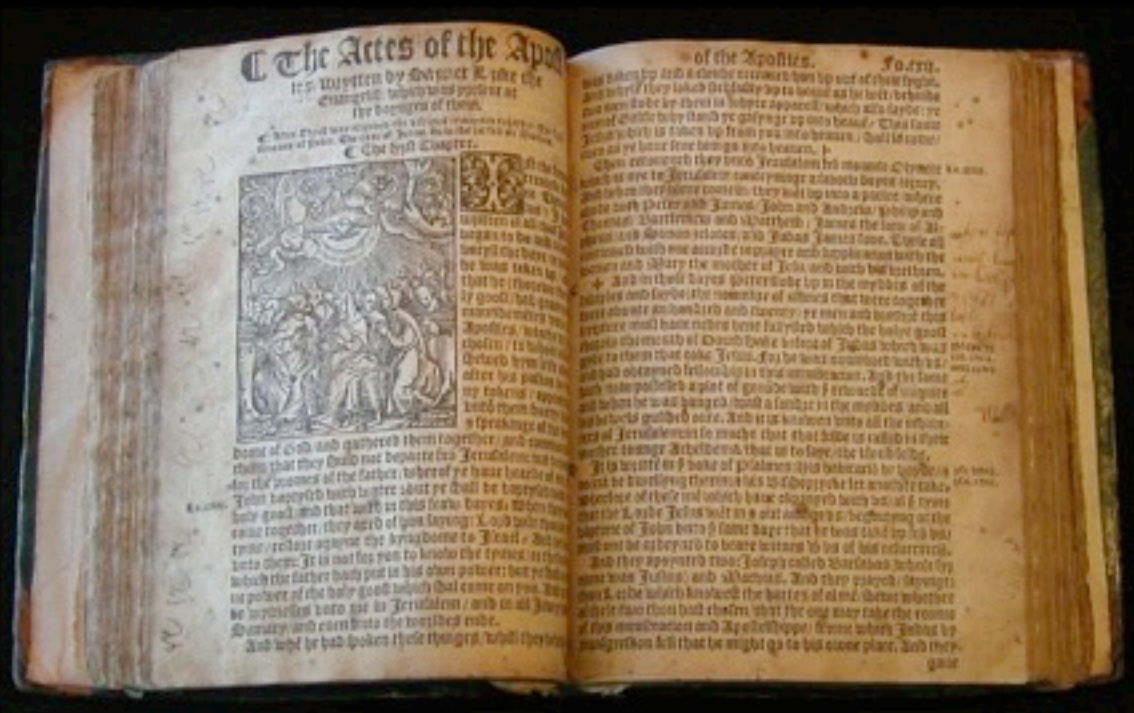


Oct 31, 1517
Luther Posts
the
Ninety-Five
Theses



REFORMATION
READ THE BIBLE
EDUCATION

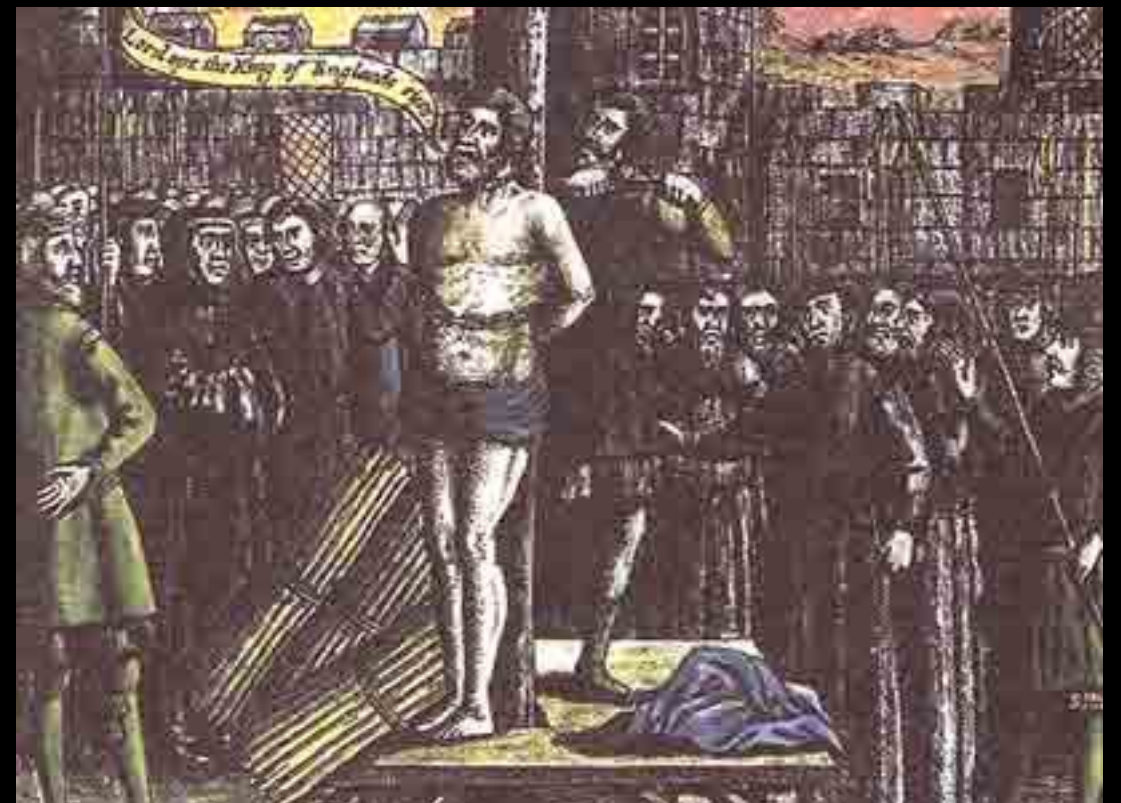
EDUCATION
FEEDS
SCIENCE





William Tyndale
1494-1536

Tyndale's translation was the first English Bible to draw directly from Hebrew and Greek texts, the first English one to take advantage of the printing press, and first of the new English Bibles of the Reformation.
Tyndale burned to death, 1536





THE POWER OF PRINTING
TYNDALE BIBLE
CIRCULATED EVEN
THOUGH GOV OF
HENRY VII TRIED TO
STOP IT.

Tyndale
Printing
Freedom
Freedom of thought
Reformation
Science

William Tyndale
1494-1536

REFORMATION GOOD FOR SCIENCE
CREATES MULTIPLE AUTHORITIES

THE POWER OF PRINTING EAST AND WEST



Sultan Selim I
1465-1520

ISLAM AND PRINTING 1515

Sultan prohibits
use of printing press.

Anyone found using
printing press
would be sentenced
to death.

Edict holds throughout
the Ottoman Empire

Istanbul and the Observatory

Taqi was a Muslim polymath: He was the author of more than ninety books on a wide variety of subjects, including astronomy, clocks, engineering, mathematics, mechanics, optics and natural philosophy



Work on the observatorium of Taqi ad-Din, (1526-1585)



In 1574 the Ottoman Sultan Murād III invited Taqī ad-Dīn to build the Istanbul observatory. The Sultan paid for it. Using his exceptional knowledge in the mechanical arts, Taqī ad-Dīn constructed huge instruments that would allow him to observe the comet of 1577.

Work on the observatorium of Taqi ad-Din, (1526-1585)



Work on the observatorium
of Taqi ad-Din, (1526-1585)

In 1577 a comet appeared
in the sky for many days.
The Sultan asked Taqi to
interpret the Comet. Taqi
accepted and said the
comet predicted a triumph
for the Turkish forces.

**Religious authorities
intervened with the
Sultan and denounced
such interference with
powers of Allah. “Prying
into the heavens is
blasphemous.”**



In 1580 the Observatory was torn down. Not til the time of Atatürk in the 20th Century did Turkey return to advanced scientific research and a newly modernized University of Istanbul.

Work on the observatorium of Taqi ad-Din, (1526-1585)



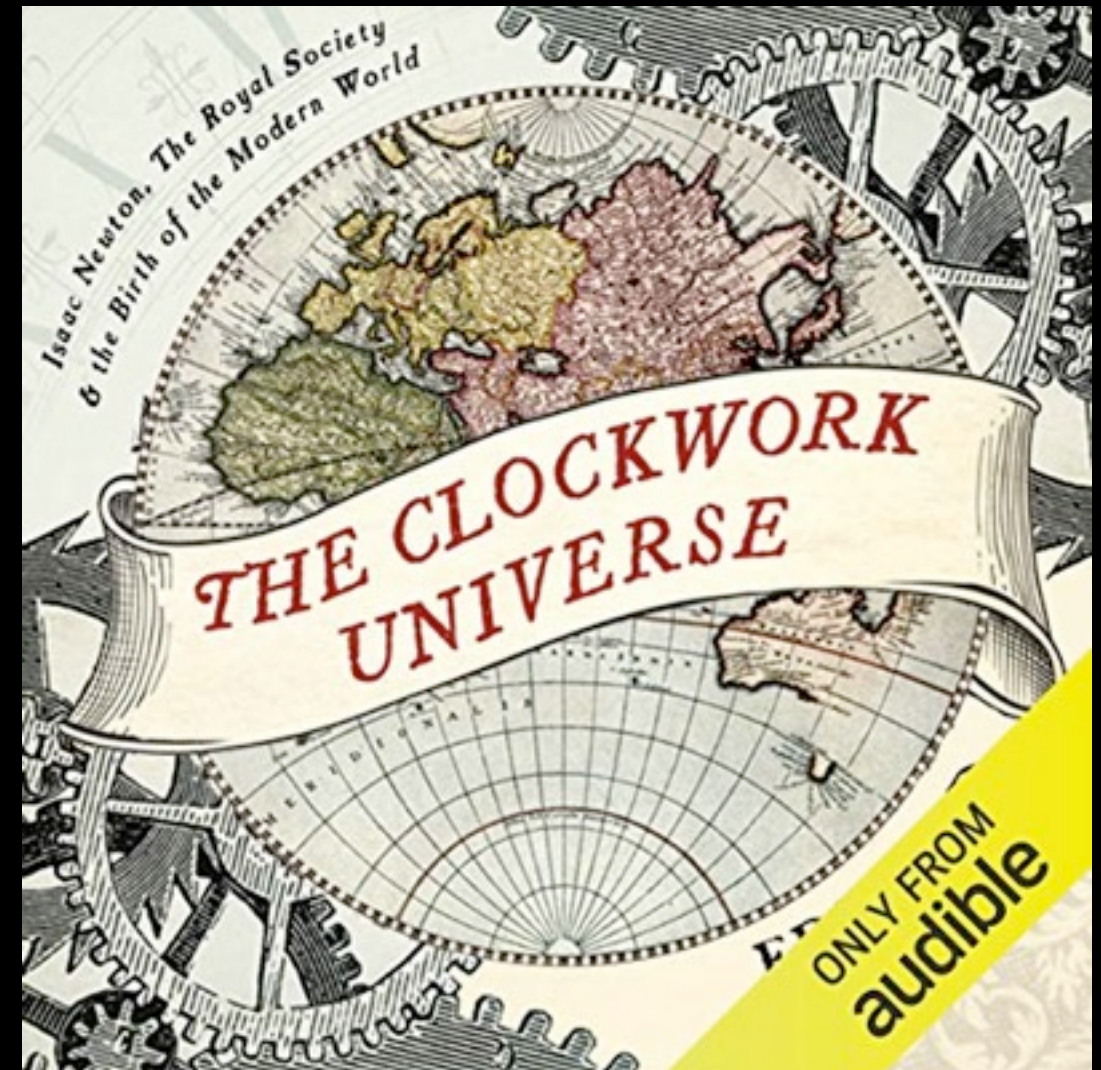
1. Science in the Ancient World: Greece
Science in the Ancient World: Israel
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3. Science in the Ren-Ref
4. Science and Time
5. Science in the Seventeenth Century



The Birth of Science and the Idea of the Cosmos



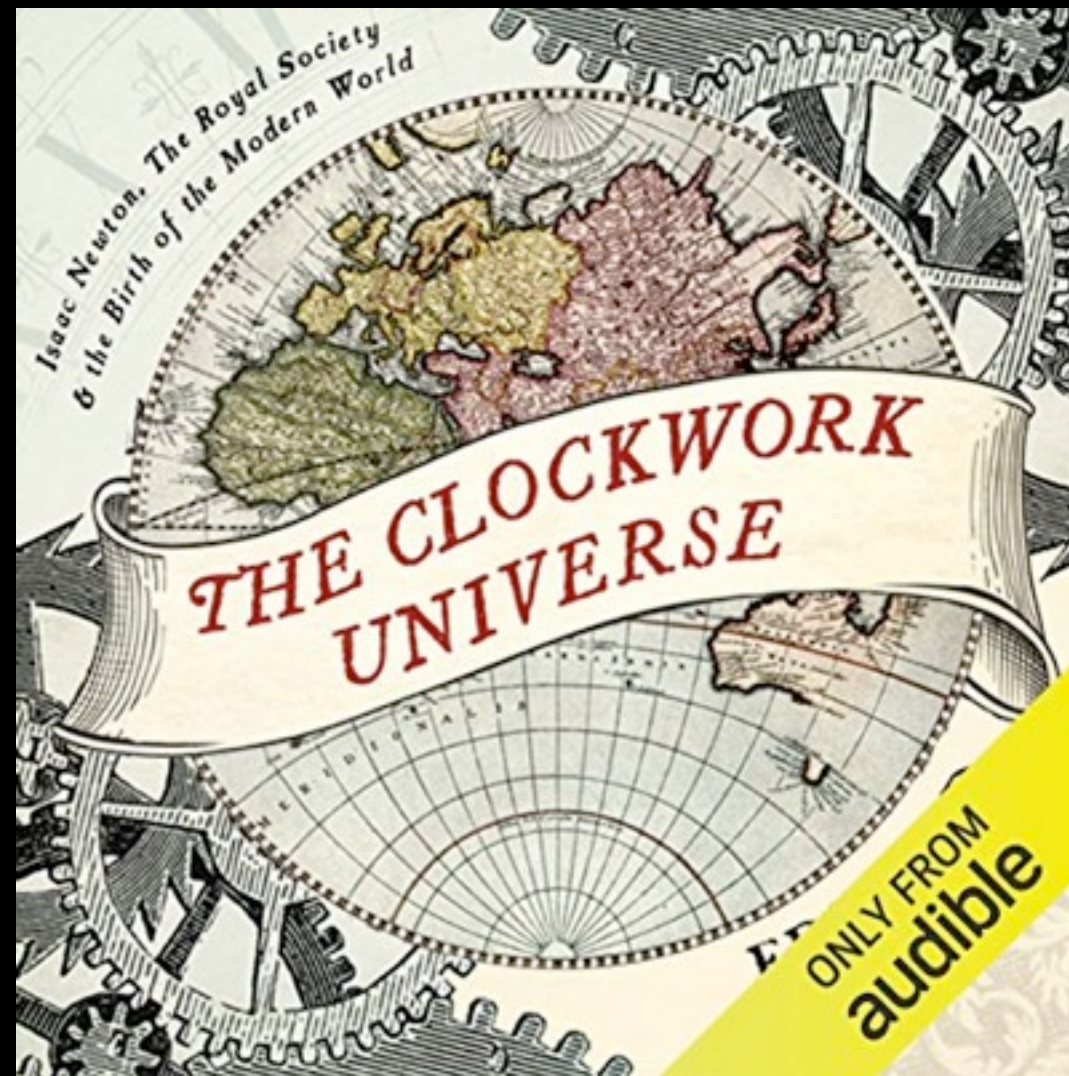
THE GREEKS



17th-18th Centuries

SCIENCE TIME AND MODERNITY

Knowledge of Time, Measurement of Time and Science Inextricably Linked



Time is the indefinite continued progress of existence and events that occur in an apparently irreversible succession from the past, through the present, into the future. Time is a component quantity of various measurements used to sequence events, to compare the duration of events or the intervals between them, and to quantify rates of change of quantities in material reality or in the conscious experience. Time is often referred to as a fourth dimension, along with three spatial dimensions.

THE CLOCKWORK UNIVERSE

SCIENCE AND TIME

SCIENCE TIME AND MODERNITY

MODERNITY=CHANGE

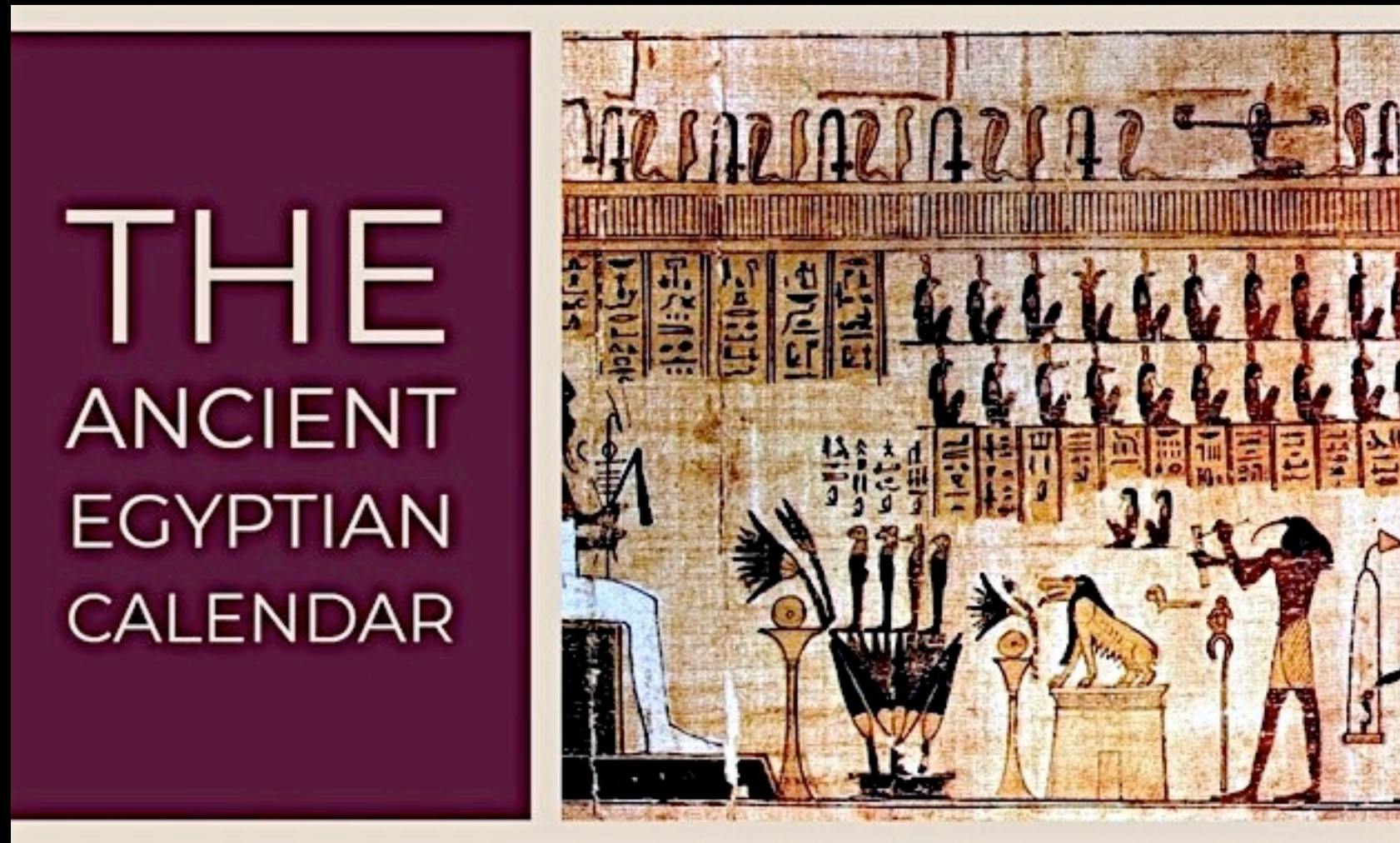
CHANGE REQUIRES A CLOCK TO KEEP
TRACK OF THINGS

SCIENCE REQUIRES A CLOCK (Experiments)

THE CLOCK/WATCH is the SINGLE MOST
CENTRAL DEVICE OF MODERNITY

6000 BC BEFORE THE CLOCK: THE CALENDAR

YEARS
&
MONTHS

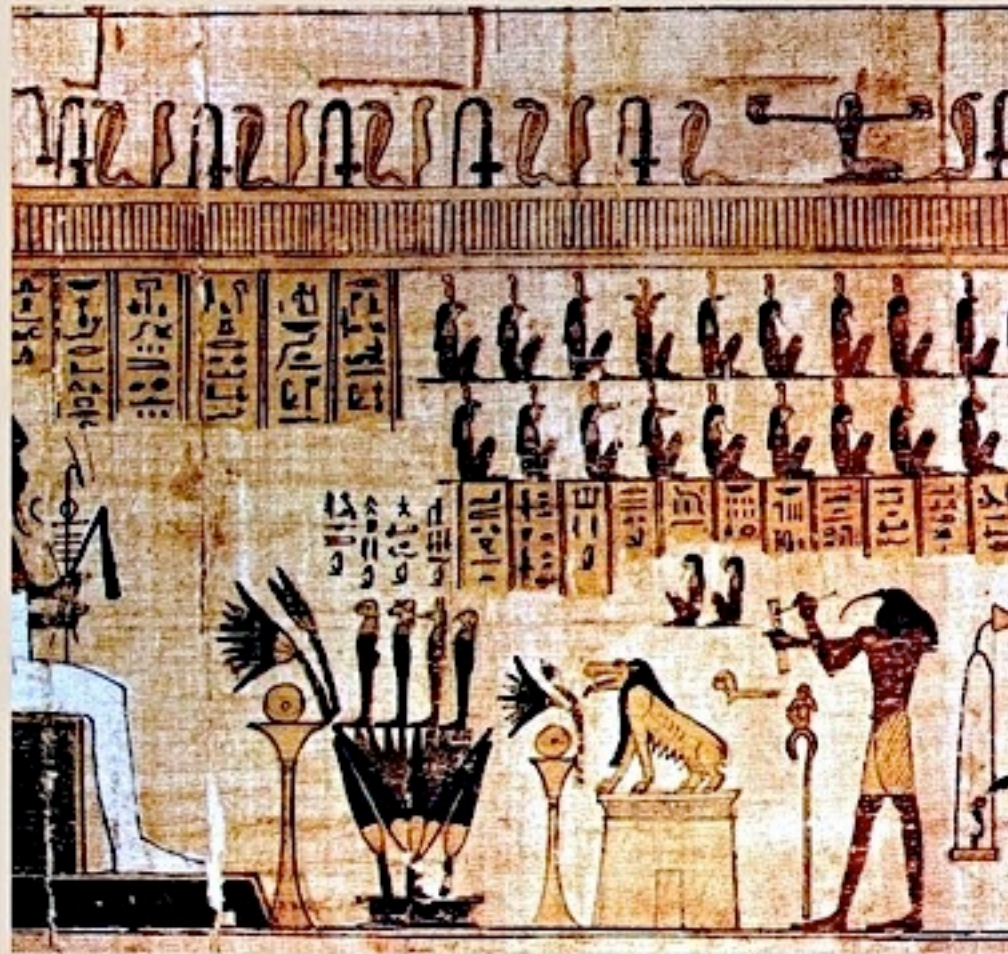


EGYPT AND MESOPOTAMIA

Artifacts from the Paleolithic suggest that the moon was used to reckon time as early as 6,000 years ago.

Lunar calendars were among the first to appear, with years of either 12 or 13 lunar months (either 354 or 384 days).

THE ANCIENT EGYPTIAN CALENDAR

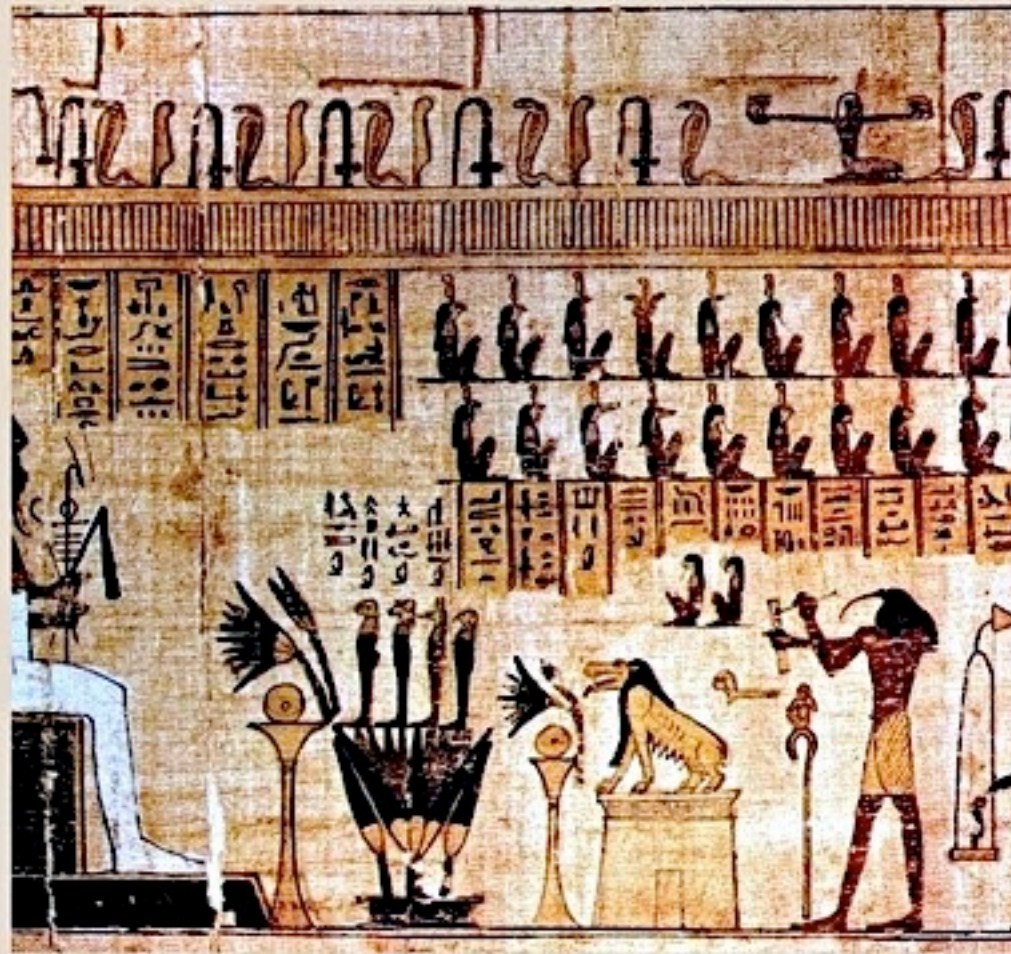


THE JEWS
GIVE US
THE
DAYS
AND WEEKS

IN 2020
THE
SEVEN
DAY
WEEK
UBIQUITOUS
(Western
Civilization)



THE ANCIENT EGYPTIAN CALENDAR



THE JEWS
GIVE US
THE
DAYS
AND WEEKS

WHY

HISTORY
IS
SACRED

YOU NEED
DAYS
AND
WEEKS TO
TELL
HISTORY



THE INVENTION OF THE EQUAL HOUR YOU NEED FOR SCIENCE

Monasteries
Worship
Bells



Cities, Churches, Bells, Worship, Mark the Day, the Time



BELL TOWER



Cities,
Churches,
Bells,
Worship,
Mark the Day,
the Time

BELL TOWER



Cities, Churches, Bells,
FLORENCE

Badia bell calls Dante
neighborhood to prayers

word "clock" from Dutch
clok=bell glock (GERMAN)
(Glockenspiel)

remember the relat between
the bell tower(Venice) and the
clock..

It was the bell that announced
Mass that was the first public
clock announcing the
canonical hours.









THE BELL TOWER

THE CITY CLOCK

THE INVENTION
OF THE EQUAL HOUR

THE
SECULARIZATION
OF
TIME



THE GREAT CLOCKTOWER RACE





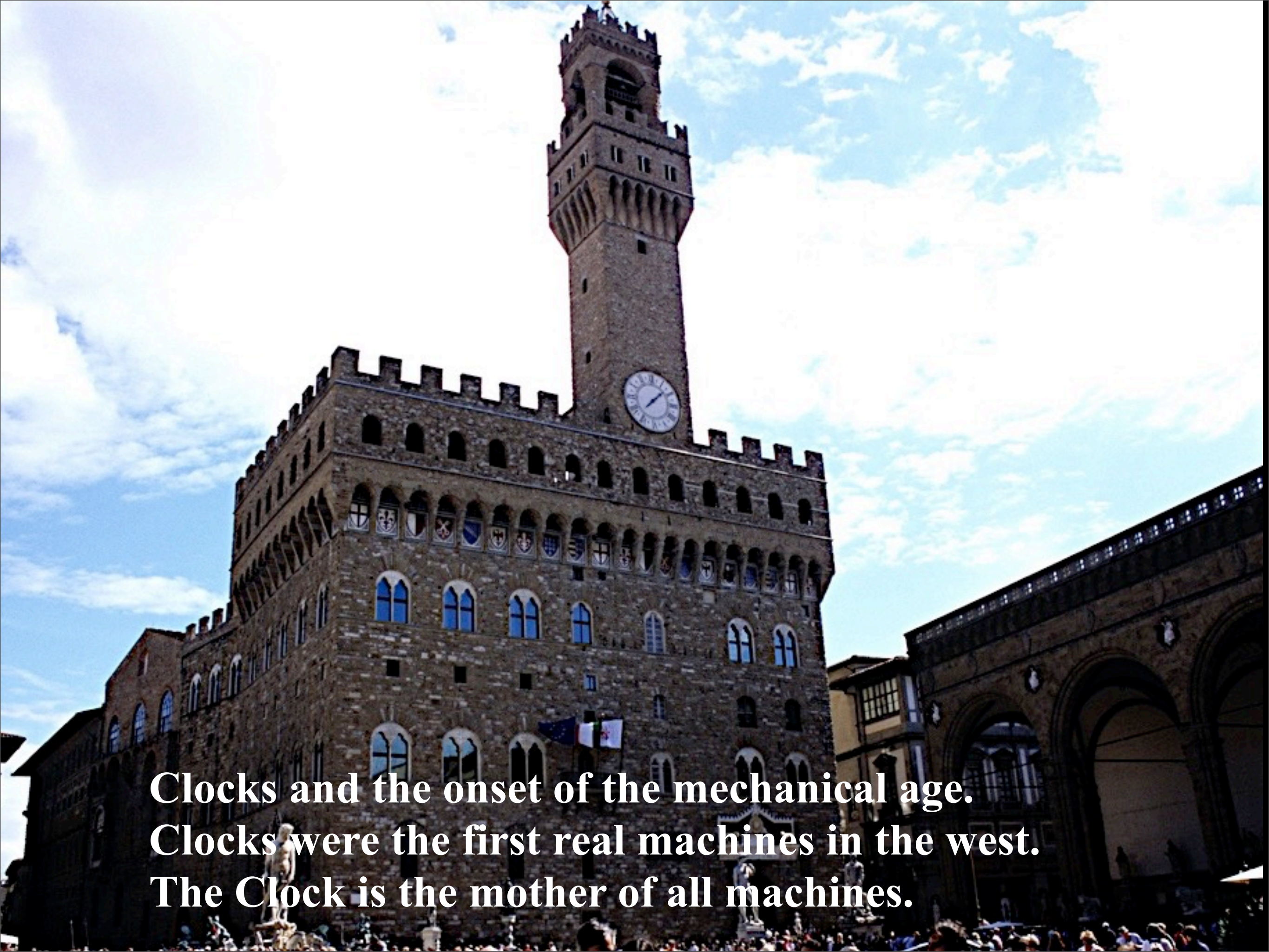


The big movement through 14thC as symbolized in Venice is to move the clock away from the church and into the hands of the city on the city hall...as in Florence (1300) sign of the times.....

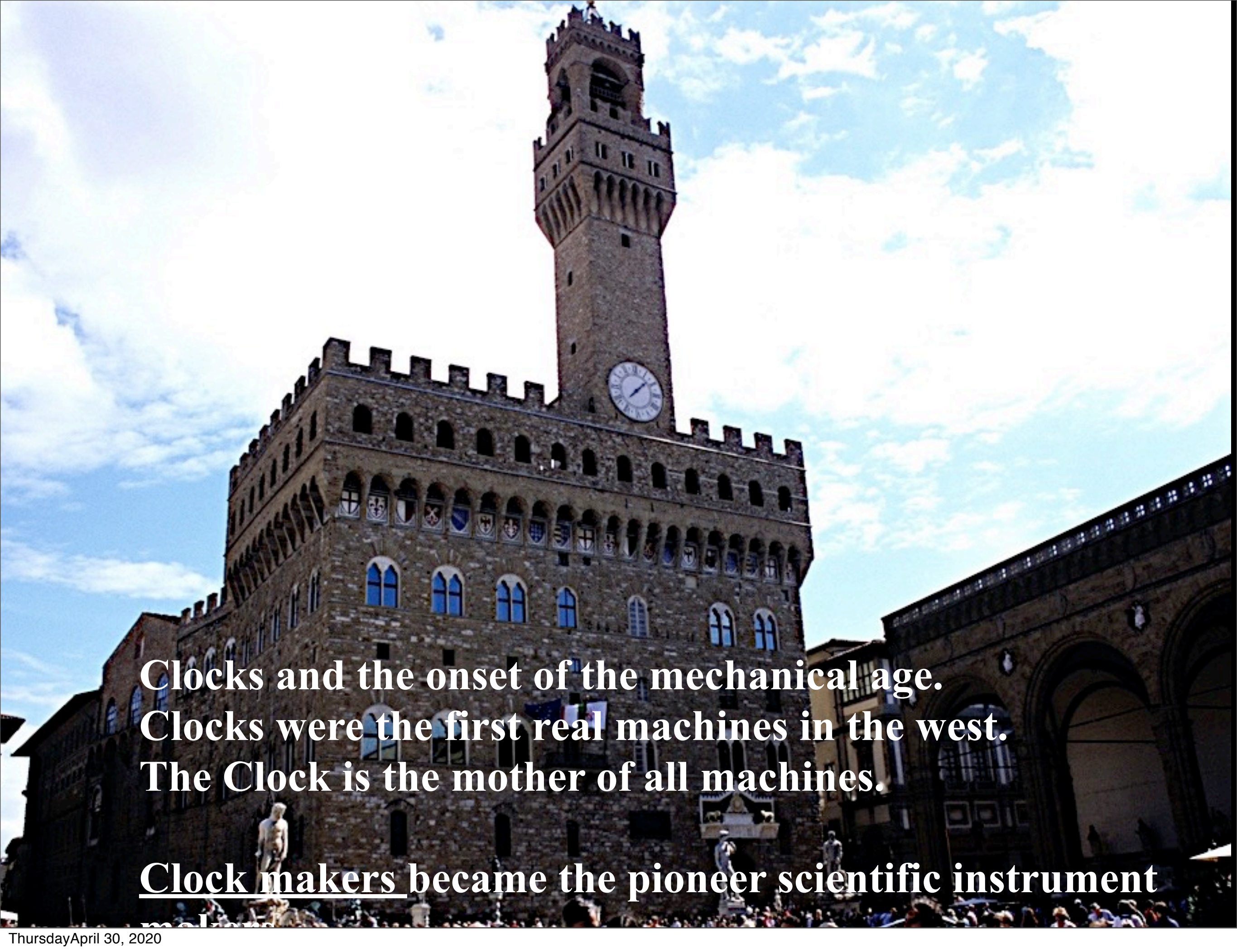


THE BIRTH OF THE EQUAL HOUR

(essential for science)



**Clocks and the onset of the mechanical age.
Clocks were the first real machines in the west.
The Clock is the mother of all machines.**



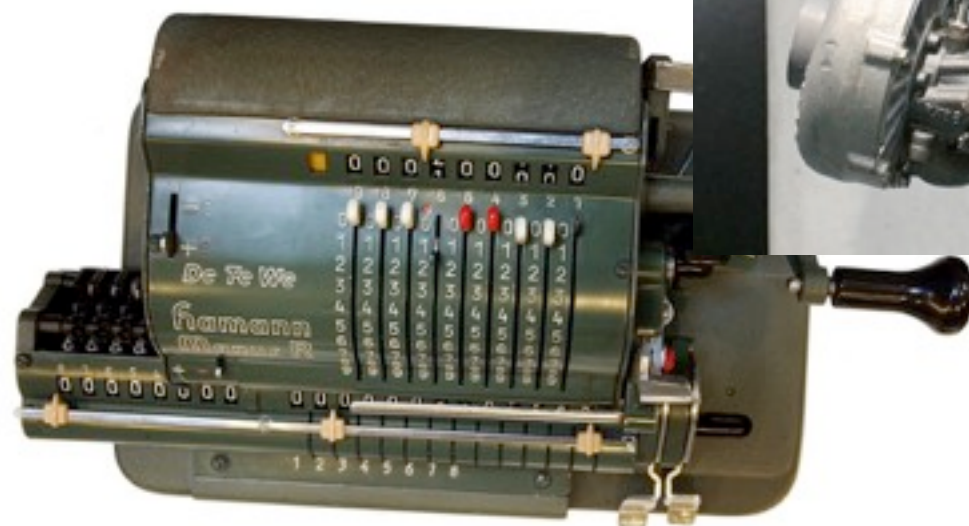
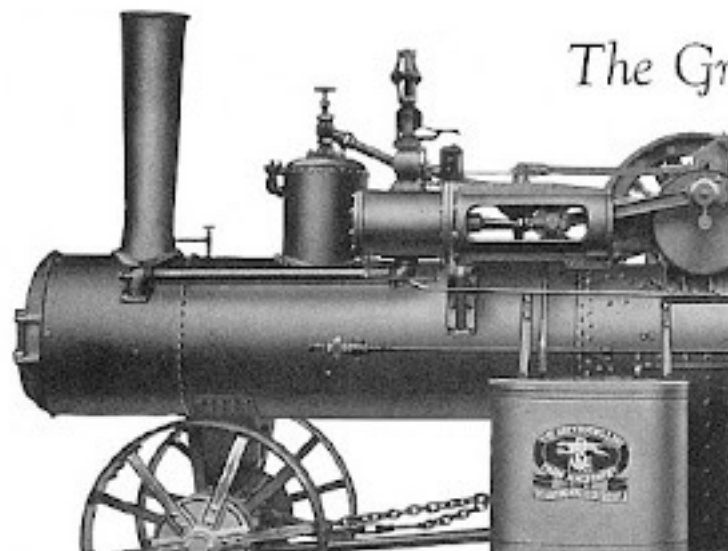
**Clocks and the onset of the mechanical age.
Clocks were the first real machines in the west.
The Clock is the mother of all machines.**

Clock makers became the pioneer scientific instrument



**Clock makers
became the pioneer scientific instrument makers.
Clocks required first real high degree of precision in
machines. One of greatest revolutions in all human history:
the movement from the variable hour(sun) to mechanical
hour...equal hour...thus human controlled hour.**

THE CLOCK IS THE BEGINNING OF THE MECHANICAL AGE



A Revolution in Time and Science

Mechanical Clocks

better than sand clocks, better than water clocks
better than sundials.

Mechanical clocks create THE EQUAL HOUR
1300-1400



Mechanical clocks create THE EQUAL HOUR 1300-1400

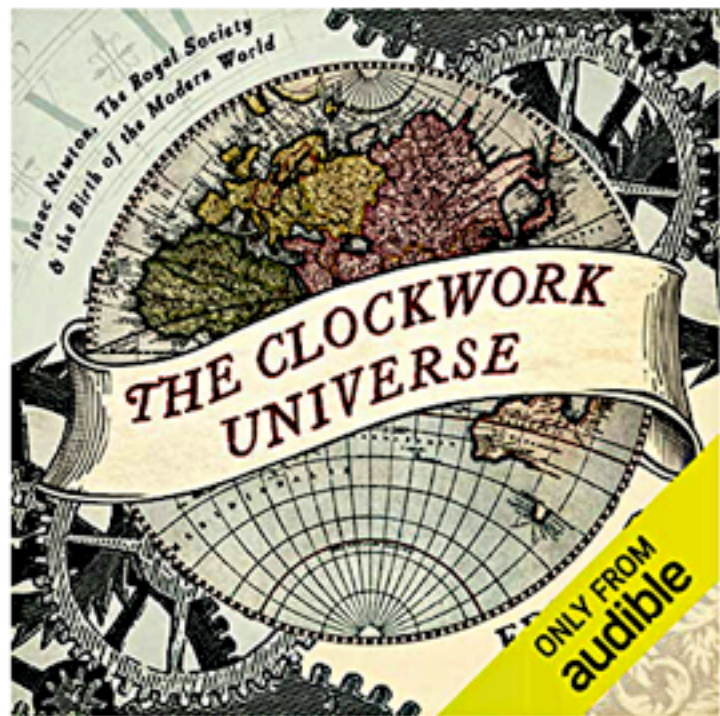
The equal hour is essential to science.
You need to document every experiment:
when, where, time, duration, etc etc






BY 1600 LONDON AND GENEVA ARE THE TWO INTERNATIONAL CENTERS OF THE MAKING OF PRECISION CLOCKS



[Back to results](#)



 Audible Sample

The Clockwork Universe: Isaac Newton, The Royal Society, and the Birth of the Modern World  Audible Audiobook – Unabridged
Edward Dolnick (Author), Alan Sklar (Narrator), & 1 more
★★★★★  196 ratings

[See all 7 formats and editions](#)

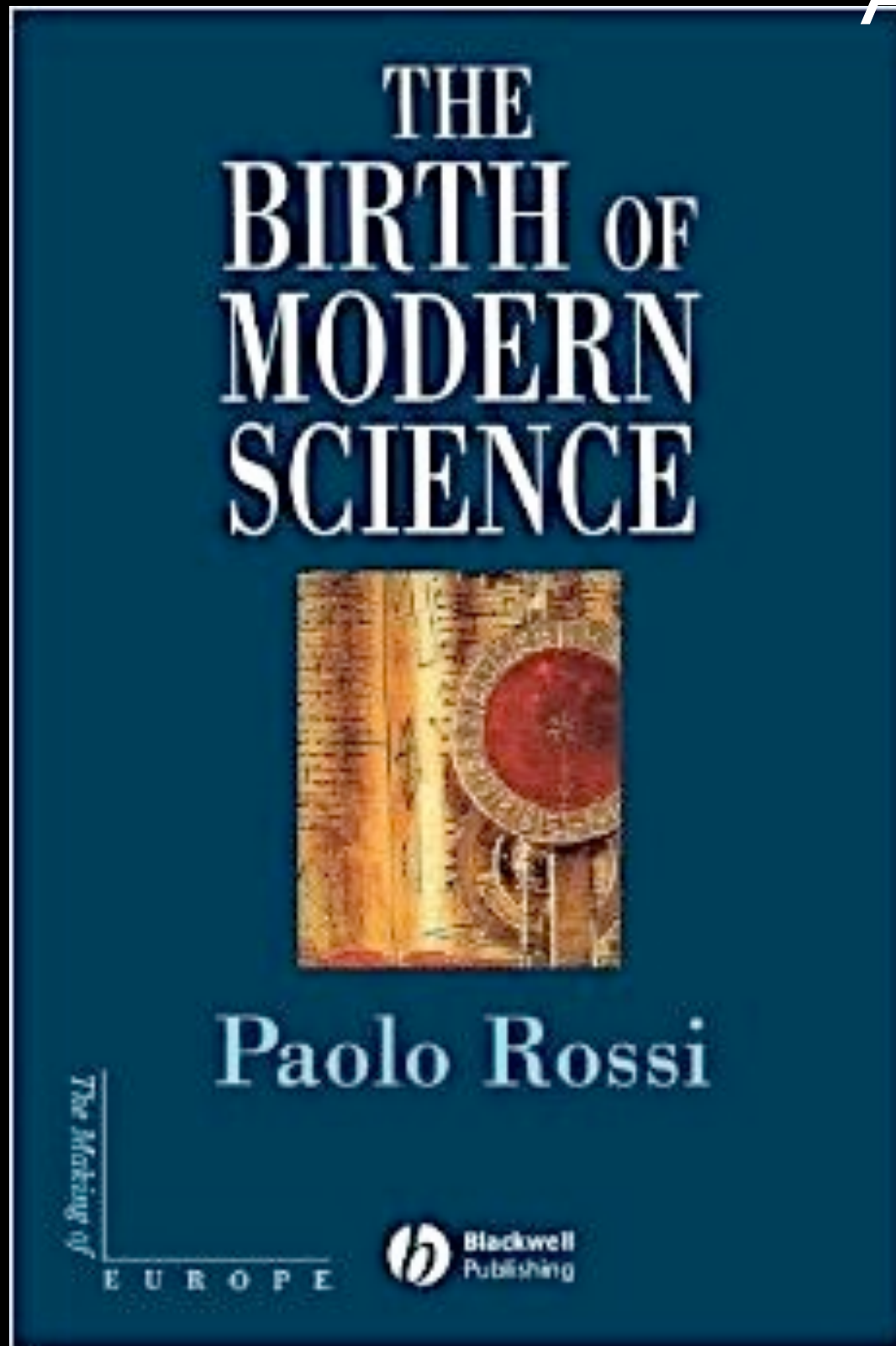
Kindle	 Audiobook	Hardcover	Paperback	MP3 CD
\$0.00 <small>kindleunlimited</small>	\$7.49 or 1 credit	from \$3.91	\$11.69	\$9.99
Read with Kindle Unlimited to also enjoy access to over 1 million more titles \$13.99 to buy	or 1 credit	44 Used from \$3.91 15 New from \$34.99	47 Used from \$4.24 22 New from \$9.99	1 New from \$9.99



1. Science in the Ancient World: Greece
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5. Science in the Seventeenth Century



THE SEVENTEENTH CENTURY AND THE BIRTH OF MODERN SCIENCE



1. England
2. Protestants
3. Printing
4. Education
5. Universities
6. Freedom of thought

THE BIRTH OF MODERN SCIENCE



Paolo Rossi

The Making of

EUROPE



Blackwell
Publishing

HERBERT BUTTERFIELD

THE ORIGINS OF MODERN SCIENCE

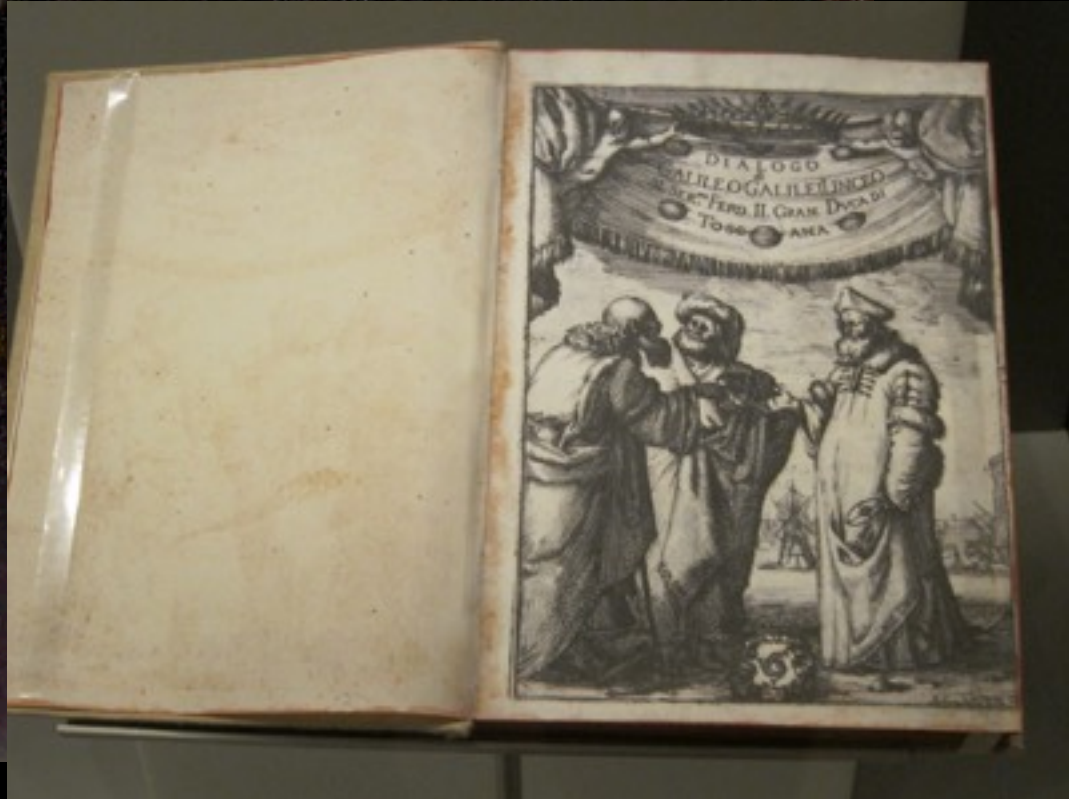
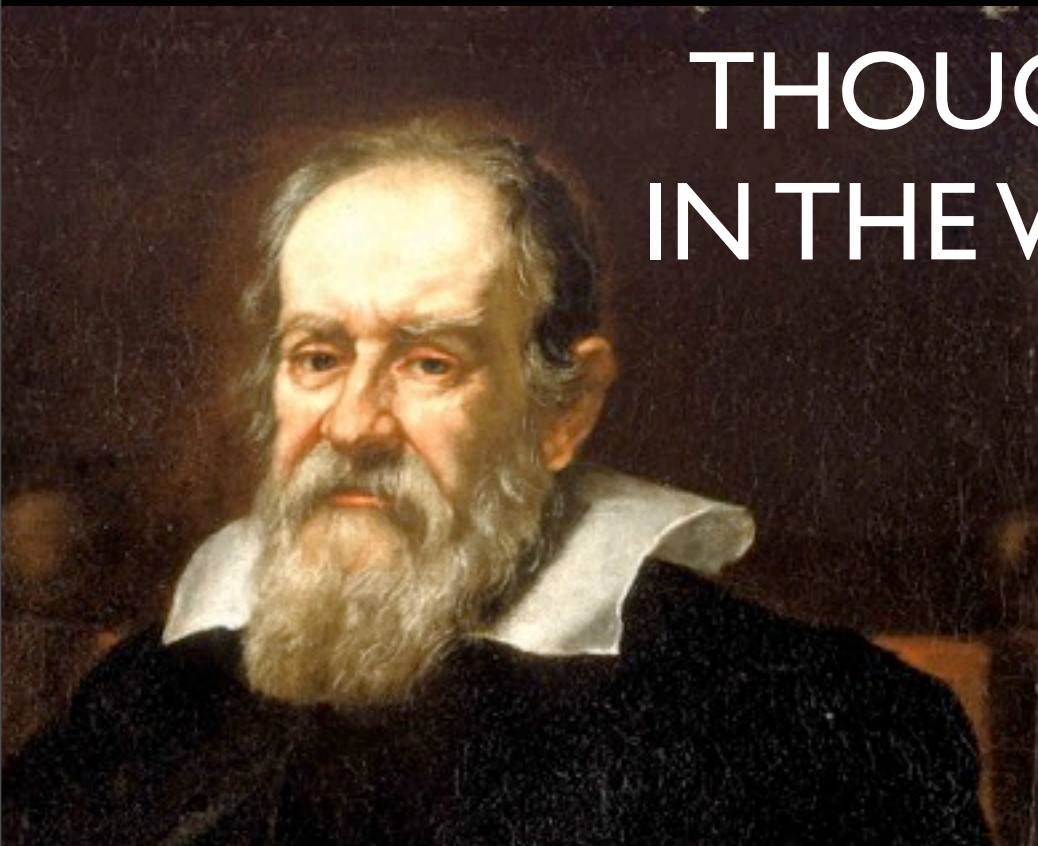
REVISED EDITION

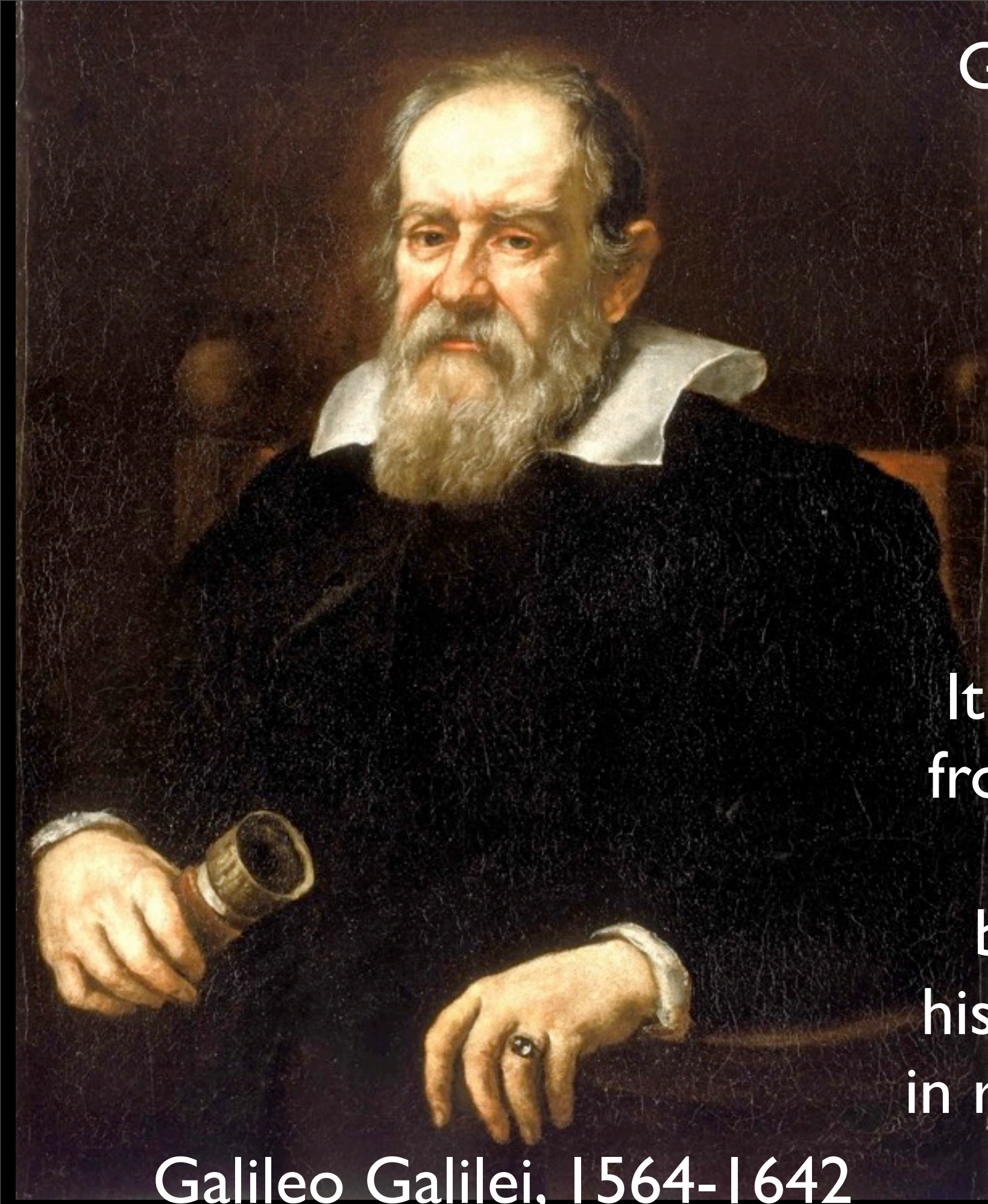
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Beginning of Modern Science

- 1530 **Paracelsus**(1493-1541), founder: toxicology, apply chemistry to physiology, pathology
- 1543 **Nicholas Copernicus**, De revolutionibus orbium coelestium
- 1543 **Andreas Vesalius**(1514-1564), De humani corporis fabrica ANATOMY supplants Greek Galen
- 1546 **Agricola** (1494-1555), De natura fossilium, introduces term “fossil”, rocks, mineralogy
- 1589 **Galileo** (1564-1642), experiments with falling bodies (experimental method)
- 1600 **William Gilbert**, De magnete, magnetisque corporibus, magnetic properties of earth
- 1608 **Hans Lippershey**, (1570-1619) invents telescope, Middleburg, Zeeland, Holland
- 1609 **Johannes Kepler** (1571-1630) laws of planetary motion, Astronomia Nova.
- 1610, **Galileo**, Starry Messenger, printed Venice. new planets Implication: Copernicus right.
- 1620, **Francis Bacon** (1561-1626), Novum organum, (The New Method)
- 1628, **William Harvey** Exercitatio anatomica de motu cordis et sanguinis in animalibus
first to describe circulation of blood and function of heart, rejects Greeks/Aristotle
- 1637, **Descartes** “La Geometrie” founds modern analytical geometry
- 1638 **Galileo**, Discorsi e dimostrazioni matematiche, foundation of modern mechanics
- 1662, **Royal Society** July 16, King Charles II grants charter, (Hooke, Newton, Boyle)
On 28 November 1660, the 1660 committee of 12 announced the formation of a "College for the Promoting of Physico-Mathematical Experimental Learning", which would meet weekly.
discuss science and run experiments. publish newsletter, articles of Royal Society 1st journal
- 1661 **Robert Boyle** (1627-1691), Skeptical Chymist founds elements/analysis of chemistry
- 1676 **Anthony van Leeuwenhoek** discovers micro-organisms with microscope
- 1687 **Isaac Newton**, Philosophiæ naturalis principia mathematica,
universal gravitation and the laws of motion.

FREE THOUGHT IN THE WEST

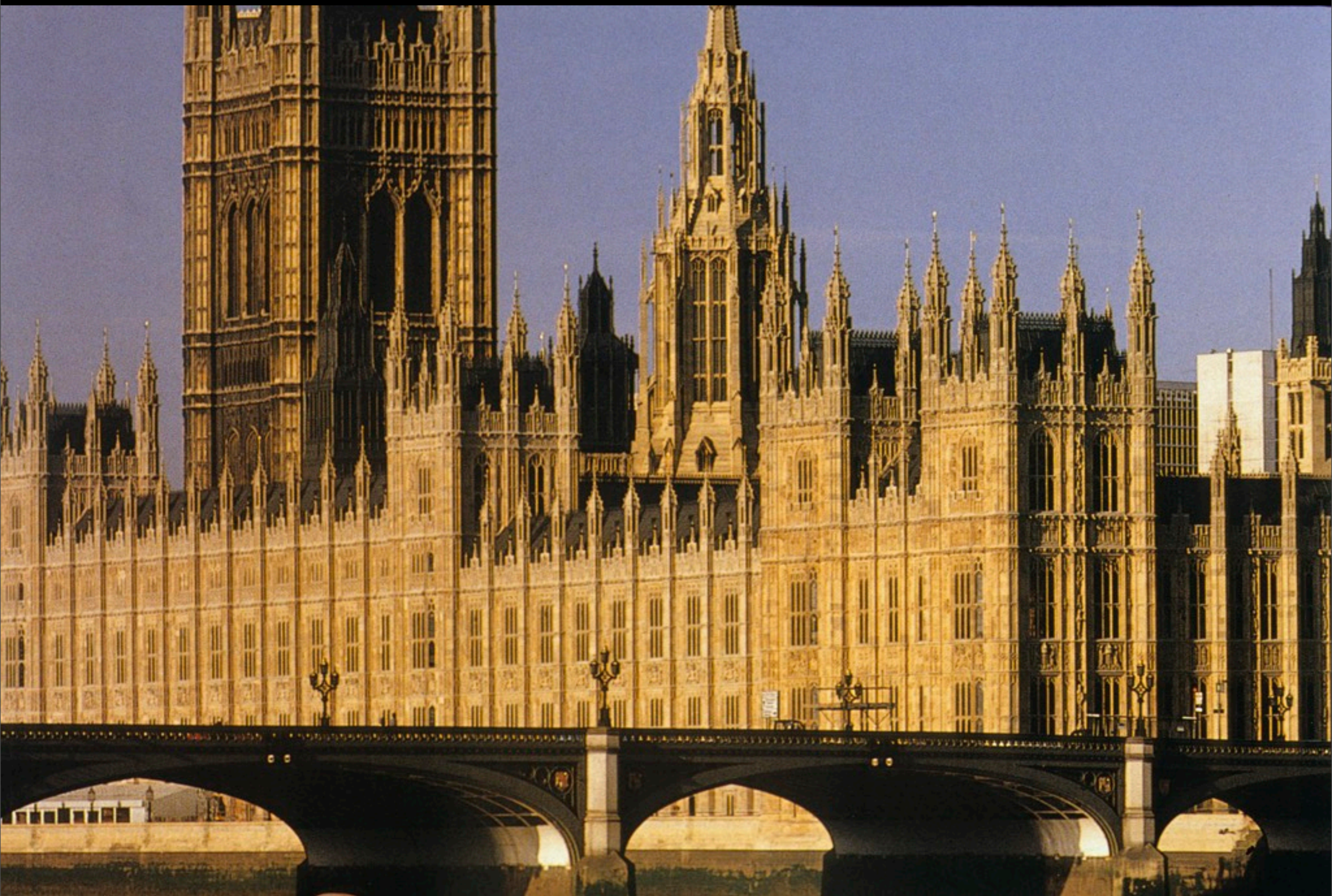


A portrait of Galileo Galilei, an elderly man with a long white beard and hair, wearing a dark robe with a white collar. He is holding a telescope in his right hand and has a ring on his left hand. The background is dark and indistinct.

Galileo's life and work
will show the
impossibility of
higher authorities
in Europe to close
down unwelcome
scientific research.

It is true they stop him
from further publication
IN ITALY,
but they cannot stop
his ideas from circulating
in rest of world of 17th C
European printing.

Galileo Galilei, 1564-1642







King Charles I and his family

CIVIL WAR 1640-1650

monarchical tyranny VS Parliament democracy





Execution of King Charles I, London 1649

AREOPAGITICA;
A
SPEECH
OF
Mr. JOHN MILTON
For the Liberty of UNLICENC'D
PRINTING,
+
To the PARLAMENT of ENGLAND.

Τῶνδ' ὅθεν δ' ἐκείνο, εἴ πεθέλει πόλις
Χρησὸν τι βέλδμ' εἰς μέσσην φέρειν, ἔχων.
Καὶ γὰρ ὁ χερζών, λαμπρὸς ἔσθ', ὁ μὴ θέλων,
Σιγῇ, τί τῶν ἐστὶν ἰσχυρὸν πόλις;
Euripid. Hicetid.

*This is true Liberty when free born men
Having to advise the public may speak free,
Which he who can, and will, deserv's high praise,
Who neither can nor will, may hold his peace;
What can be juster in a State then this?*
Euripid. Hicetid.

LONDON,
Printed in the Yeare, 1644.

Areopagitica
by
John Milton
1644
embrace
total
freedom of
speech
freedom of
print
complete
freedom of
the word.
Milton a
Puritan
democrat.

King Charles II, King of England, 1660-1685



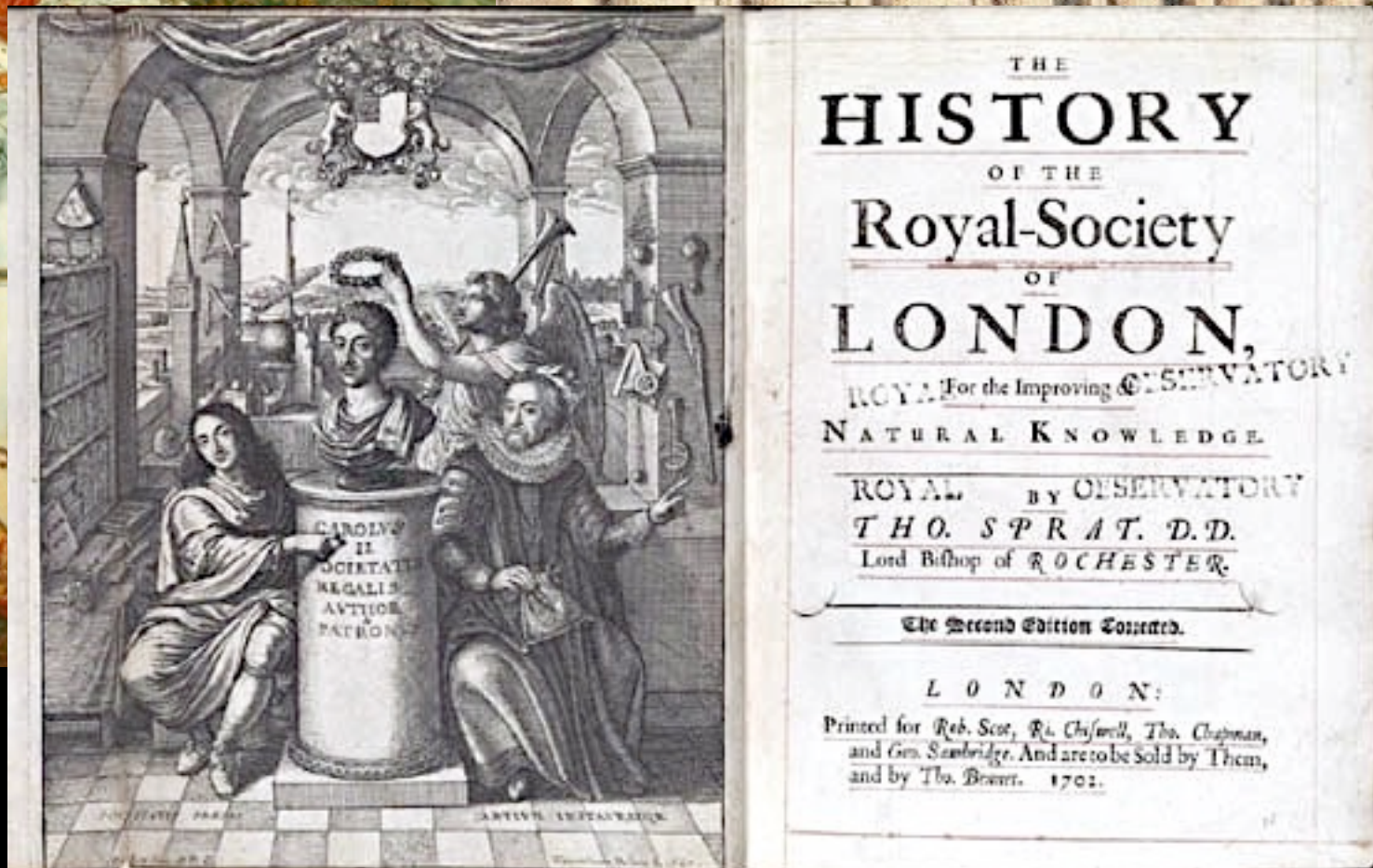
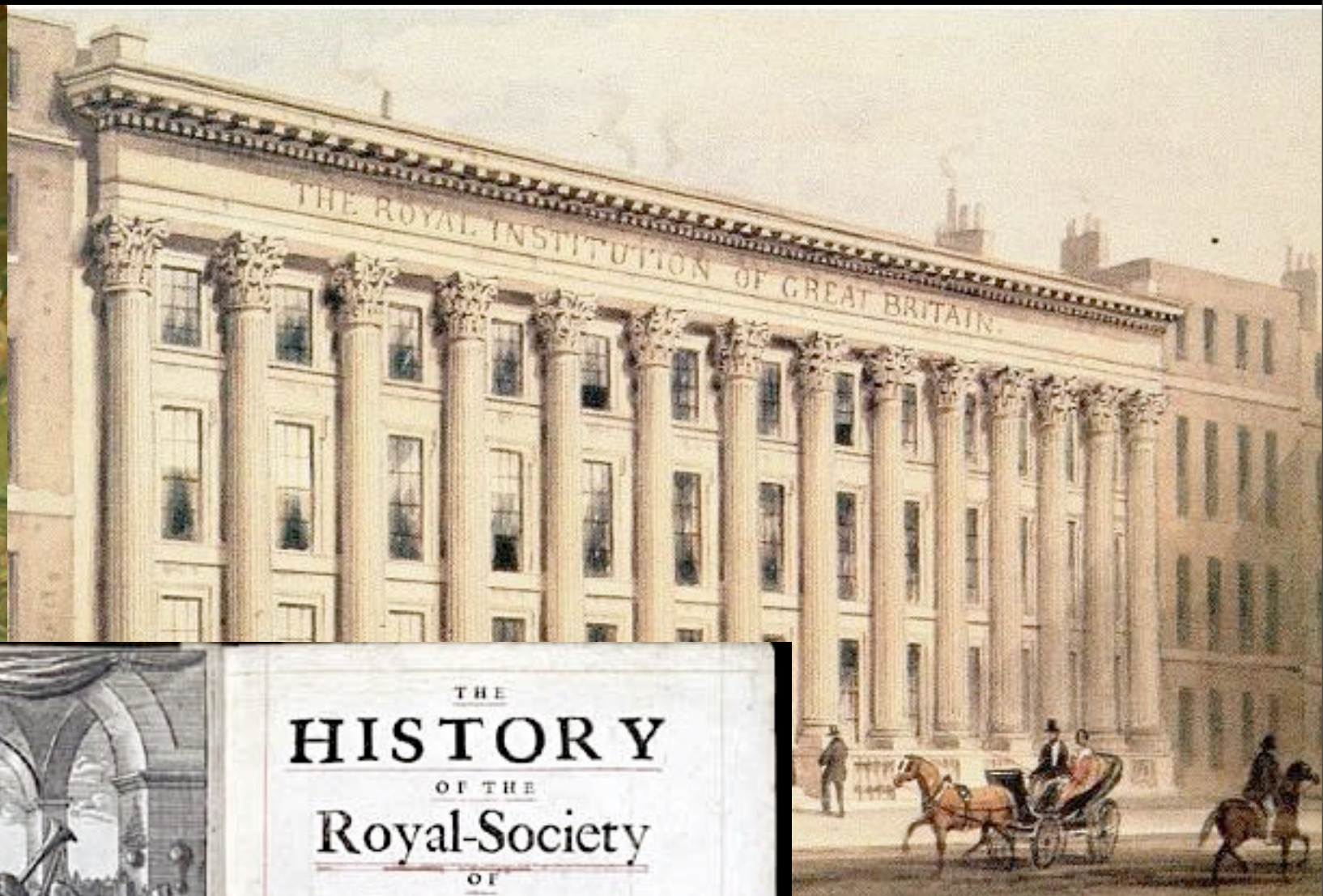
King Charles II, King of England, 1660-1685

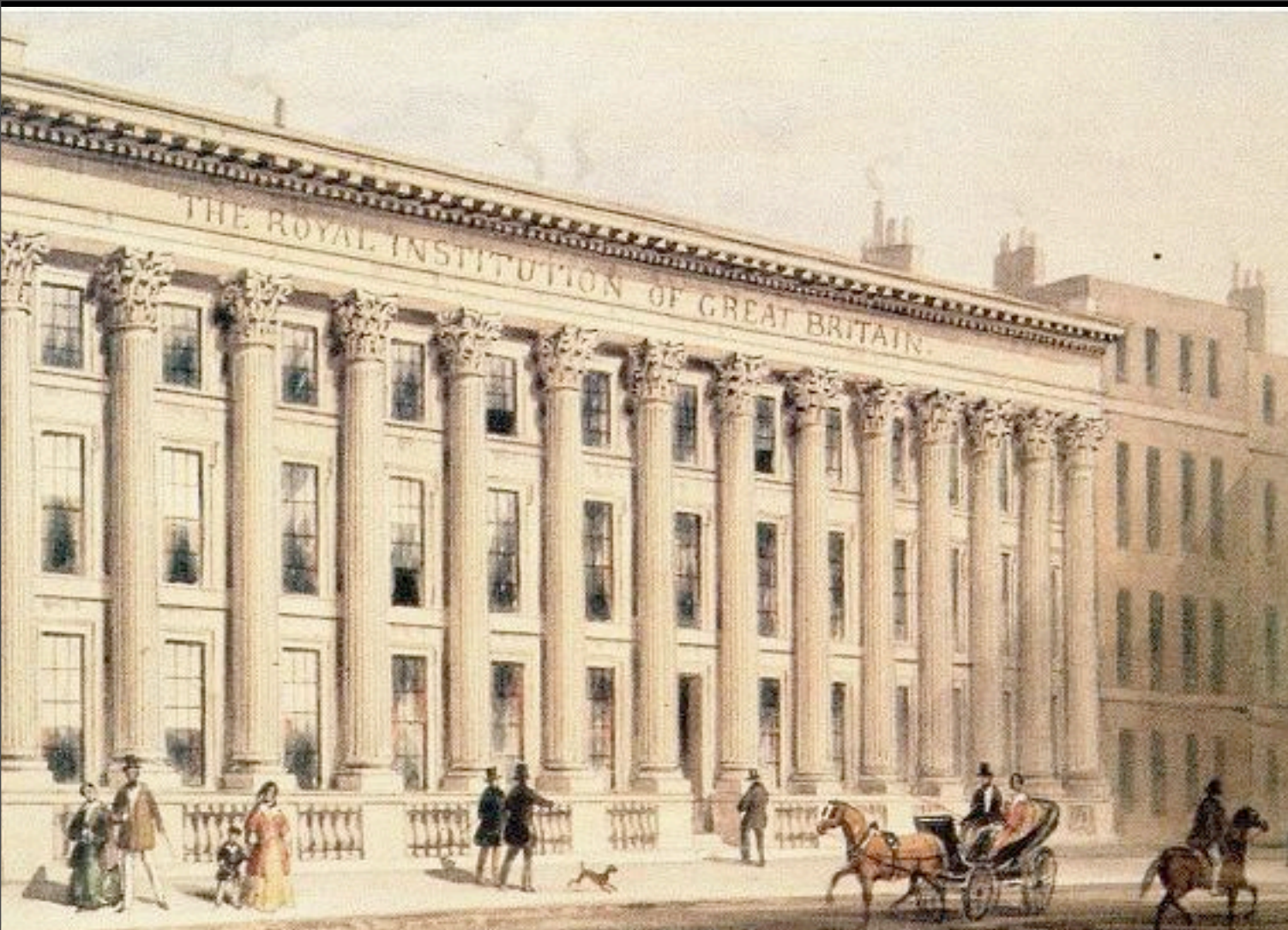


King Charles II, King of England, 1660-1685



Foundation of the Royal Society, Founded in November 1660, it was granted a Royal Charter by King Charles II.

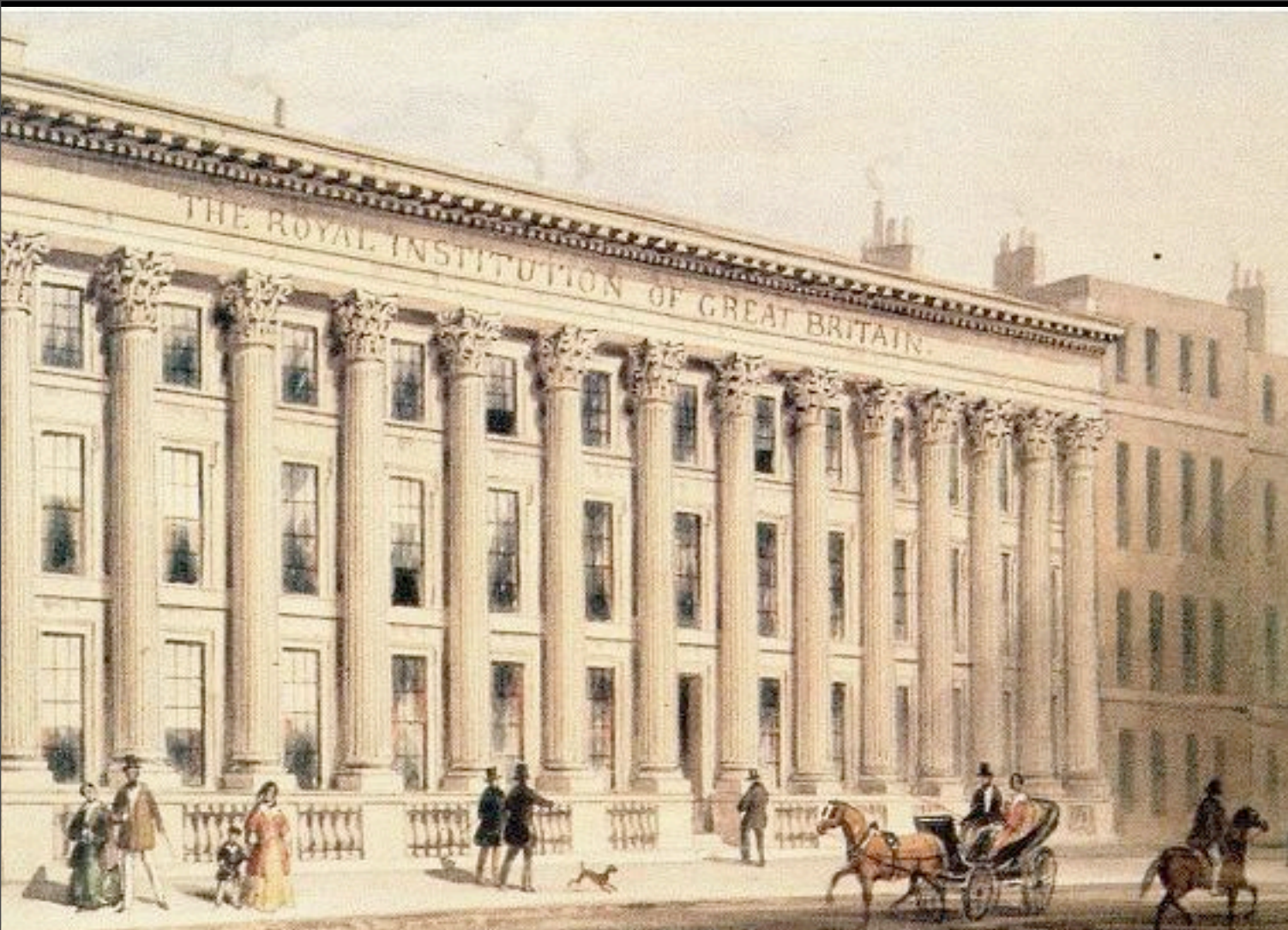




The Royal Society

1. members
2. meetings
3. papers
peer review
4. publications
5. Journal
6. Open to all
International

(Freedom of press
Freedom of debate)



The Royal Society

1. members
2. meetings
3. papers

peer review

4. publications
5. Journal
6. Open to all

International

7. English

(new international language-still true)

(Freedom of press
Freedom of debate)





ISAACUS NEWTON EQ. AUR. ÆT. 83.

J. Vanderbank pinxit 1725

Geo. Vertue Sculpsit 1726.

Robinson 17
R. Robinson
John Robinson 1827
PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.
373

AUCTORE
ISAACO NEWTONO, EQ. AUR.

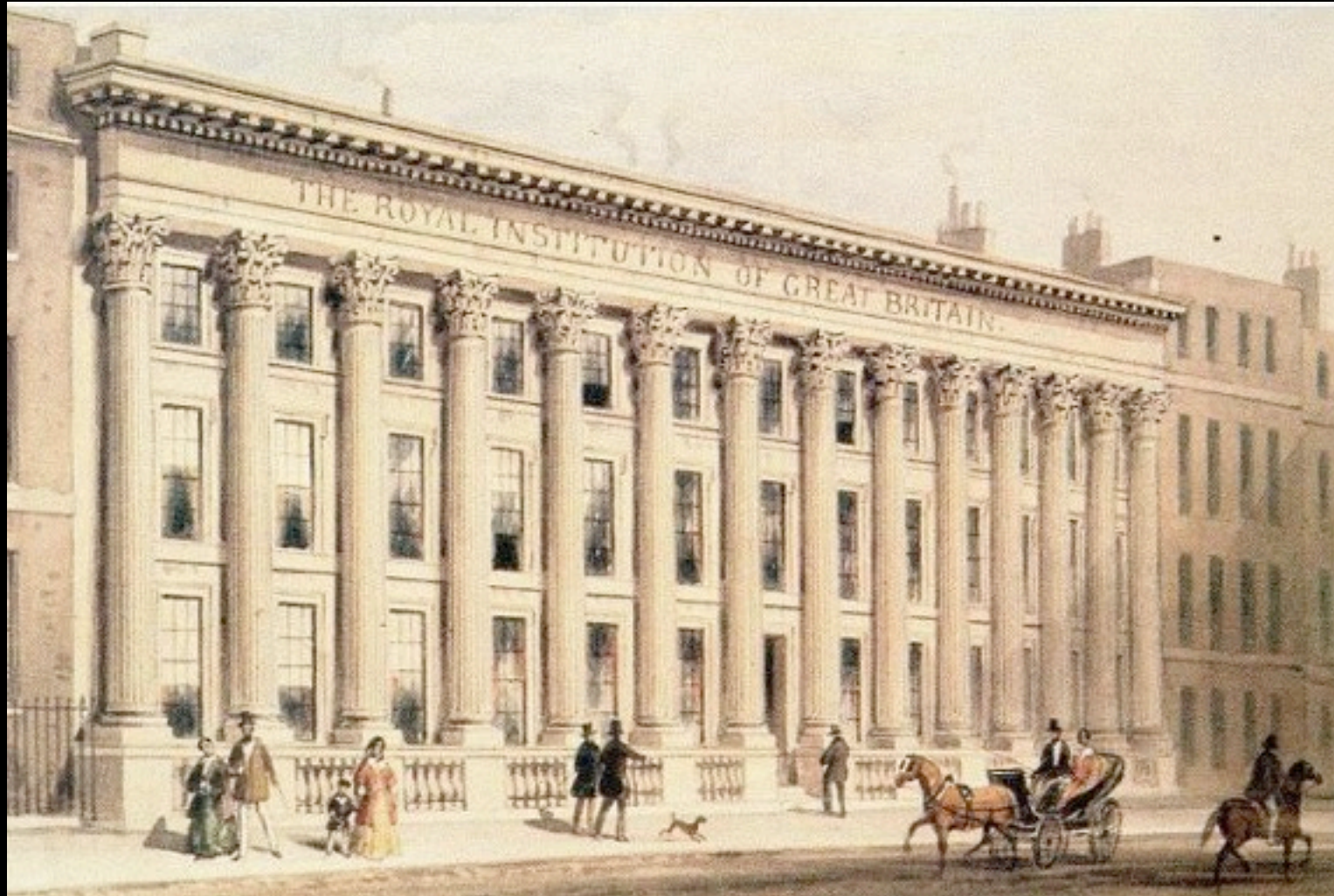
Editio tertia aucta & emendata.

LONDINI:

Apud GUIL. & JOH. INNYS, Regiæ Societatis typographos.
 MDCCXXVI.



I 660 Royal Society

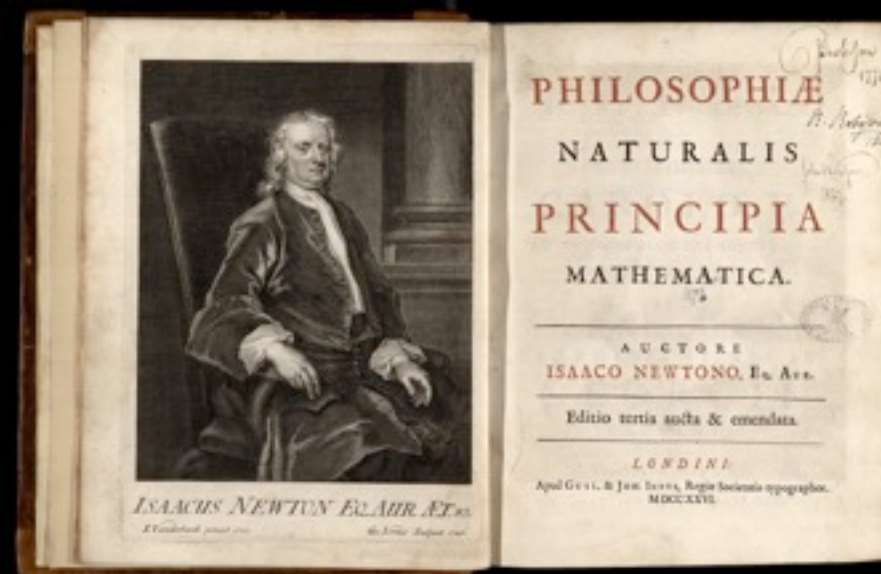
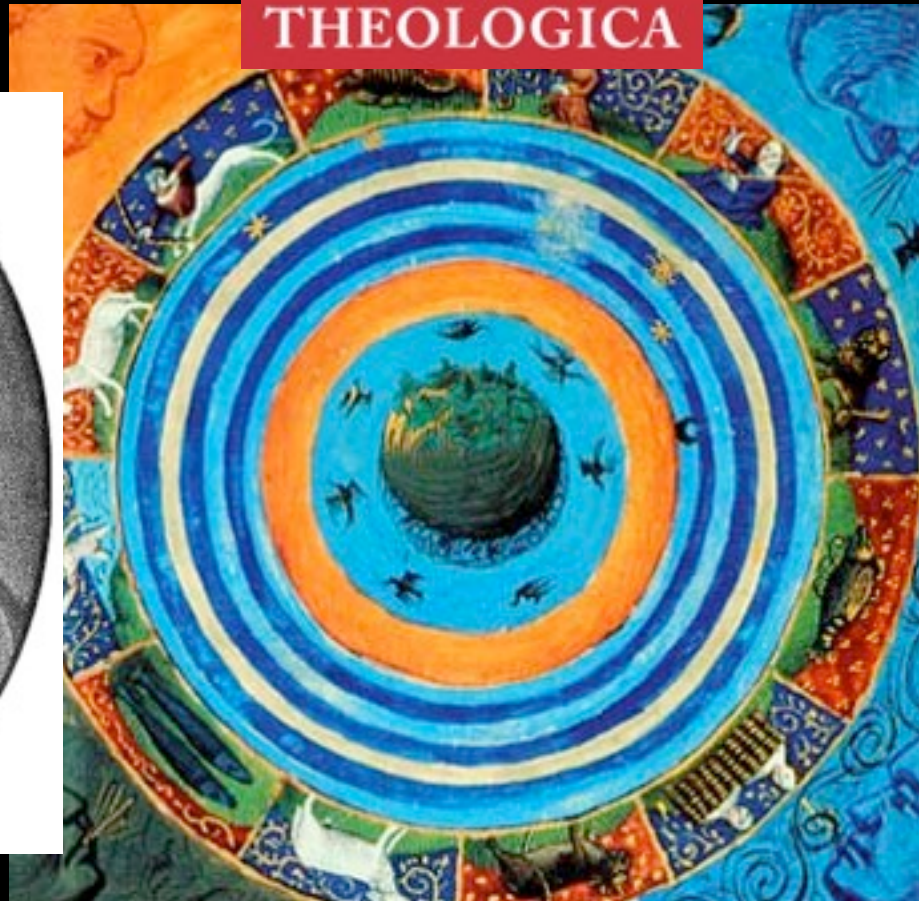
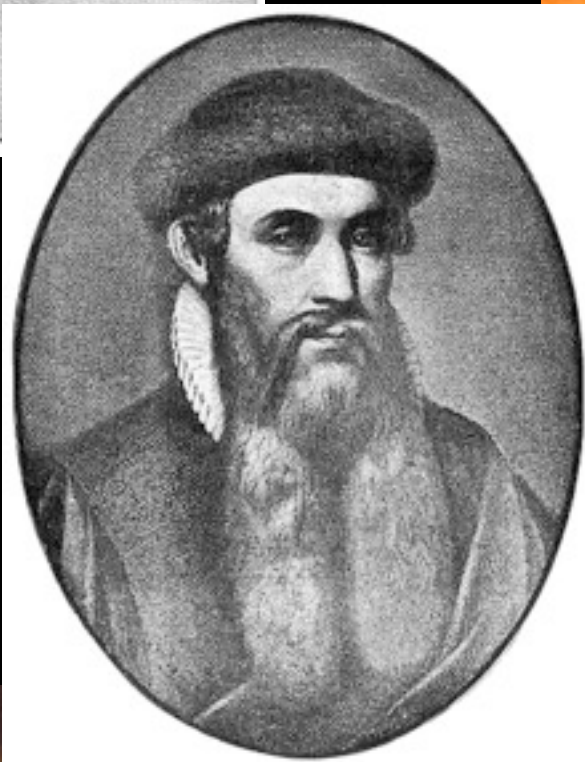
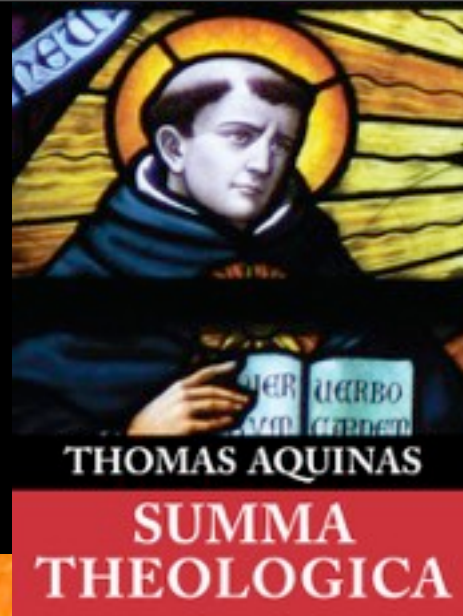
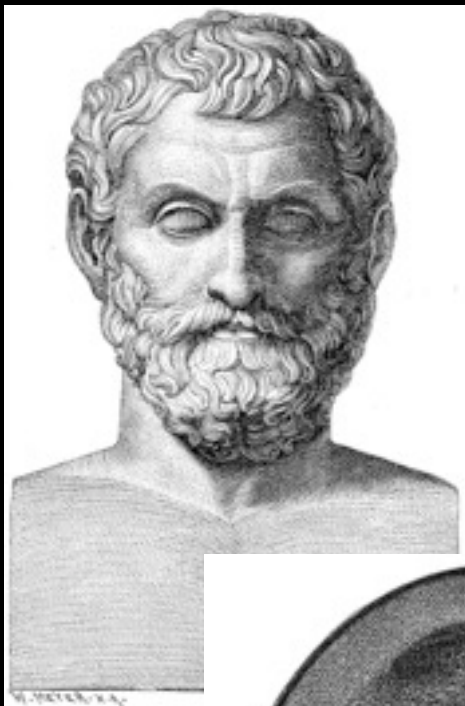


Founded in a Parliamentary, free political society.
**Successful scientific research ONLY flourishes
in free society. free speech. free press.**

ENGLAND AND THE NETHERLANDS

Dictatorships can TRY to encourage.

But it always flounders on issue of free speech.





1. Science in the Ancient World: Greece
Science in the Ancient World: Israel
2. Science in the Middle Ages
3. Science in the Ren-Ref
4. Science and Time
5. Science in the Seventeenth Century





Bach
Toccata
and
Fugue
in
D minor



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Avicenna

(Ibn Sina) 980-1037

His most famous work is *The Book of Healing*, a philosophical and scientific encyclopedia



Beginning of Modern Science

- 1530 Paracelsus(1493-1541), founder: toxicology, apply chemistry to physiology, pathology
- 1543 Nicholas Copernicus, De revolutionibus orbium coelestium
- 1543 Andreas Vesalius(1514-1564), De humani corporis fabrica ANATOMY supplants Greek Galen
- 1546 Agricola (1494-1555), De natura fossilium, introduces term “fossil”, rocks, mineralogy
- 1589, Galileo(1564-1642), experiments with falling bodies (experimental method)
- 1600 William Gilbert, De magnete, magnetisque corporibus, magnetic properties of earth
- 1608 Hans Lippershey, (1570-1619) invents telescope, Middleburg, Zeeland, Holland
- 1609 Johannes Kepler (1571-1630) laws of planetary motion, Astronomia Nova.
- 1610, Galileo, Starry Messenger, printed Venice. Implication: Copernicus right.
- 1620, Francis Bacon (1561-1626), Novum organum, (The New Method)
- 1628, William Harvey, Exercitatio anatomica de motu cordis et sanguinis in animalibus
first to describe circulation of blood and function of heart, rejects Greeks/Aristotle
- 1637, Descartes, “La Geometrie” founds modern analytical geometry
- 1638 Galileo, Discorsi e dimostrazioni matematiche, foundation of modern mechanics
- 1662, July 16, King Charles II grants charter to Royal Society, (Hooke, Newton, Boyle)
On 28 November 1660, the 1660 committee of 12 announced the formation of a "College for the Promoting of Physico-Mathematical Experimental Learning", which would meet weekly to discuss science and run experiments.
- 1661 Robert Boyle (1627-1691), Skeptical Chymist founds elements/analysis of chemistry
- 1676 Anthony van Leeuwenhoek discovers micro-organisms with microscope
- 1687 Isaac Newton, Philosophiæ naturalis principia mathematica, universal gravitation and the laws of motion.