

SCIENTIFIC THINKING

Part I

Prescientific Era (5000 BC – 1500 AD)

M N EL-Bolkainy

2013

WHY DO WE STUDY THE HISTORIC PRE-SCIENTIFIC ERA?

- 1. To obtain bird-eye-view of the problem
(advances in science are step wise)**
- 2. To learn lessons from history, thus,
avoiding repeating mistakes**
- 3. At present, some people still believe in
historic misconcepts**

Scientific Thinking

A Reader
Second Edition



The American University in Cairo

ST. PAUL · COLUMBUS · TS'AI LUN · BUDDHA
GALILEO · EINSTEIN · MUHAMMAD · JESUS
PASTEUR · NEWTON · EDISON · LAVOISIER
FARADAY · BECQUEREL
PIZZARRO · CONFUCIUS

THE 100

A RANKING OF
THE MOST INFLUENTIAL
PERSONS IN HISTORY

Michael H. Hart

MAO TSE-TUNG · MARK · MARCONI · FREUD
LOLIVAR · MICHELANGELO · POPE URBAN II
ARISTOTLE · PETER THE GREAT · NAPOLEON
LENIN · PICASSO · MALTHUS · JEFFERSON
CYRUS · GENGHIS KHAN · MOSES · CAESAR
VASCO DA GAMA · CHARLEMAGNE

THE CAMBRIDGE ILLUSTRATED HISTORY OF THE WORLD'S SCIENCE

Colin A. Ronan

LIBRARY OF THE WORLD'S MYTHS AND LEGENDS

Egyptian Mythology

LIBRARY OF THE WORLD'S MYTHS AND LEGENDS

Greek Mythology

JAMES
HARPUR

ELIZABETH HALLAM,
CONSULTANT

RELATIONSHIP

The
MEDIEVAL
WORLD

SISTER WENDY BECKETT

THE STORY OF PAINTING

THE ESSENTIAL GUIDE TO THE
HISTORY OF WESTERN ART

Contributing Consultant PATRICIA WRIGHT

A HISTORY OF ART

General Editor Sir Lawrence Gowing

Definitions

DEFINITION OF SCIENCE

- **The study of nature or human behavior**
- **Science is knowledge**

BRANCHES OF SCIENCE

I. Natural Universe, Physics,
Mathematics, Chemistry,
Biology, Botany, Medicine

II. Social Economics, Political,
Sociology, Psychology

DEFINITION OF TECHNOLOGY

**The application of science
for practical purposes
(useful or harmful)**

GAIN OF KNOWLEDGE

Dogmatic (النهج الإملائي)

(Follow Authority)

Unproved

Empirical (النهج التجريبي)

(Personal observation)

Evidence – based

- **Dogma (Doctrine) = A statement which can-not be doubted** (مبدأ أو عقيدة)

NONSCIENTIFIC ERA

1. Supernatural Concepts

The Egyptian Contribution (3000 – 400 BC)

2. Natural Concept

Greek Contribution (400 BC – 200 AD)

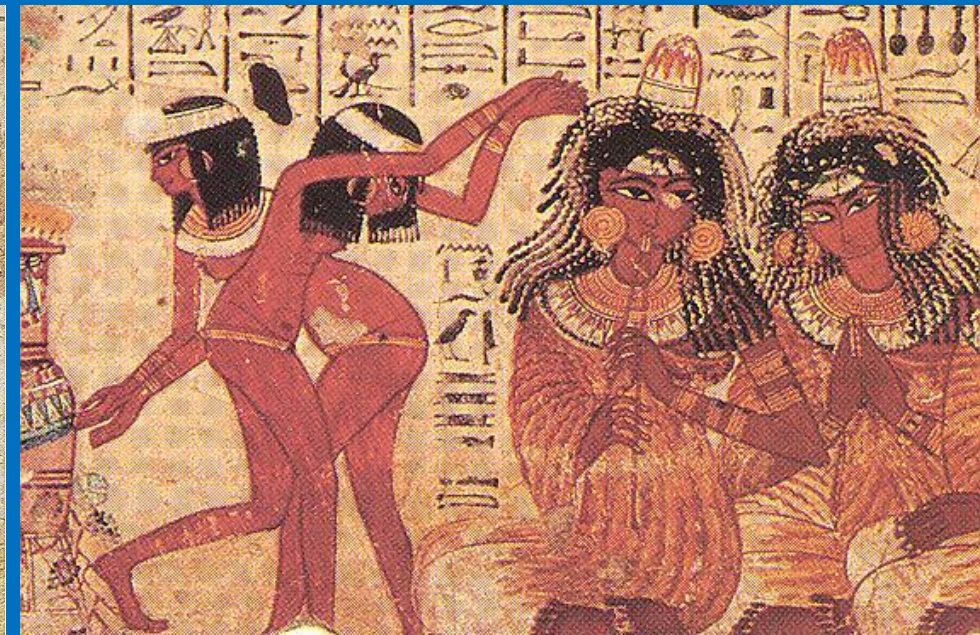
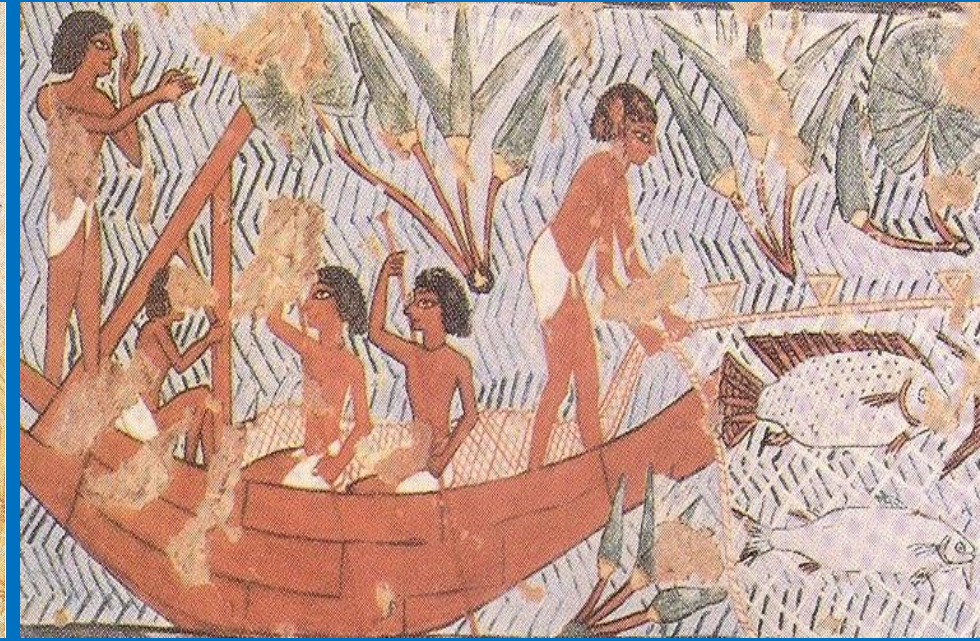
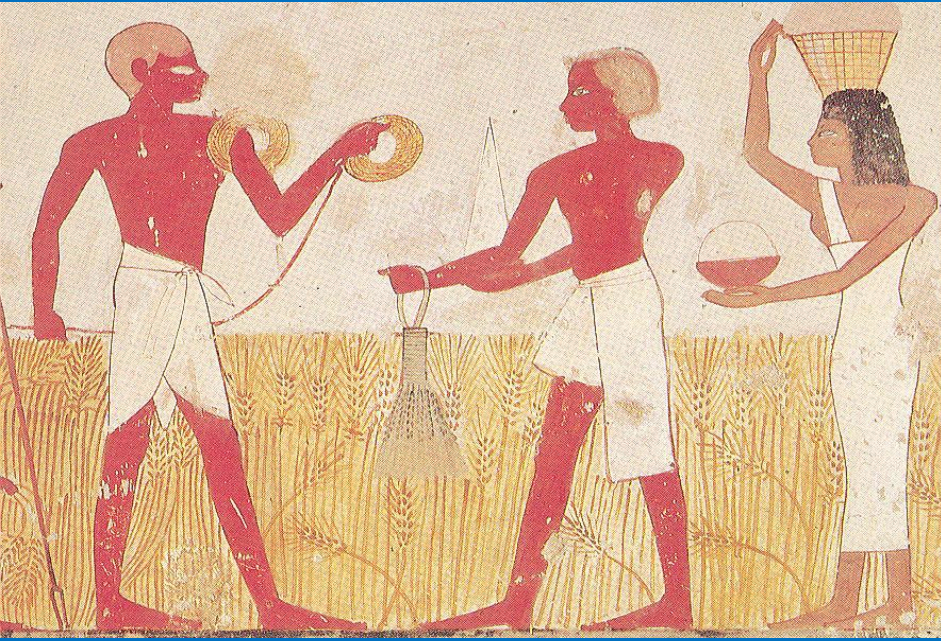
3. The Middle Ages (200 – 1500 AD)

Dark Ages in Europe

The Islamic Empire

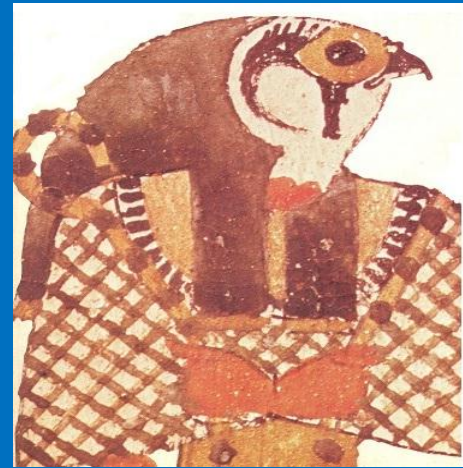
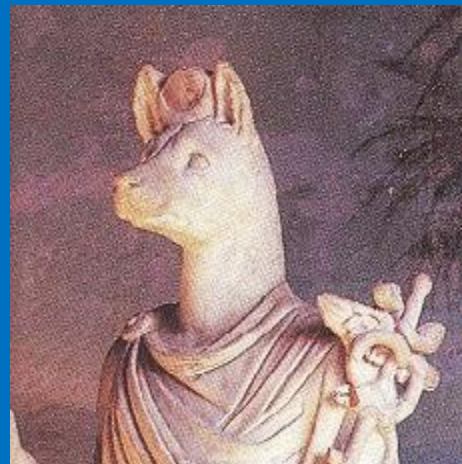
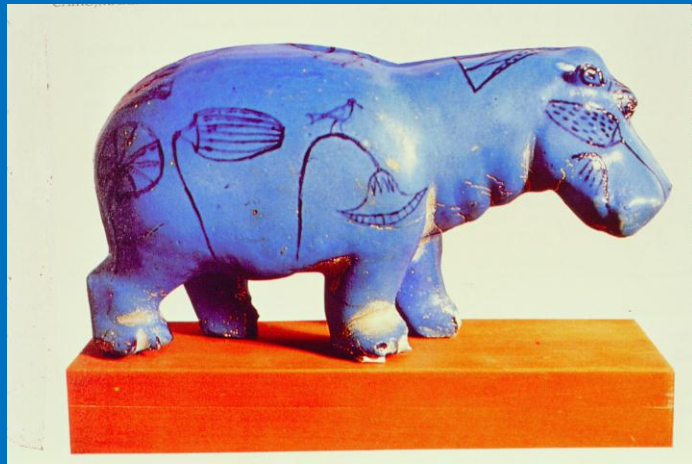
Renaissance

ANCIENT EGYPT



SUPERNATURAL CONCEPTS OF ANCIENT EGYPT

- 1. Multiple Gods (Polytheism)**
- 2. Single God (Monotheism)**
- 3. Hemi – Gods**
- 4. Afterlife (Resurrection)**
- 5. Judgment**
- 6. Evil Spirits**



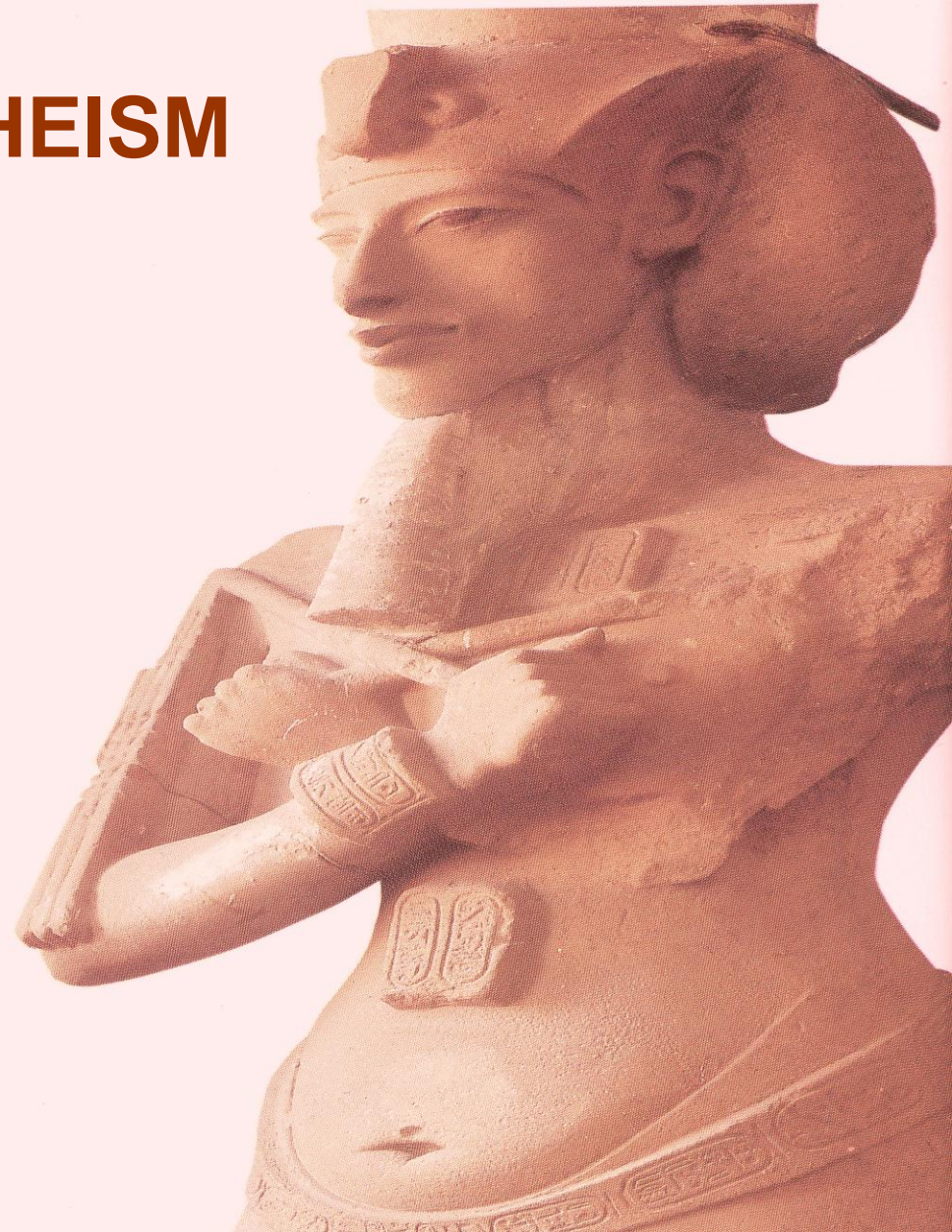


**An Ancient
Egyptian
seeking cure
from Horus**

MONOTHEISM



Moses (1391-1271)



Akhenaten (1380-1334 BC)



Akhenaton, Nefertiti and God Aten



Horus embracing KING Khafre

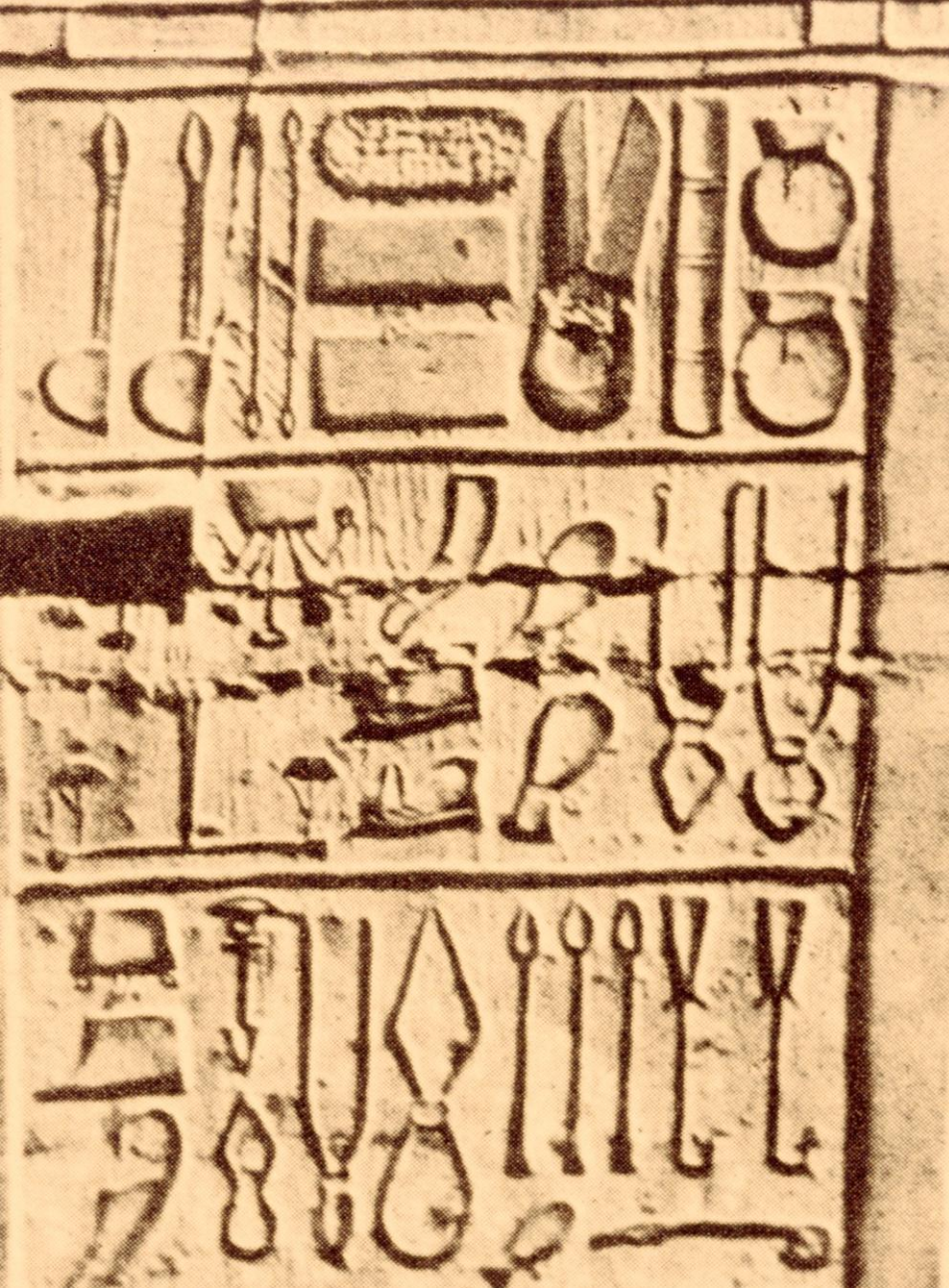
TWO DANGEROUS CONCEPTS INVENTED BY ANCIENT EGYPTIANS

- 1. Consideration of their rulers
(Pharaohs) as supermen and hemi-Gods**
- 2. The use of religion (by Pharaohs)
to accomplish political and personal goals**

THE IMPORTANCE OF A CORRECT THEORY

A wrong theory (Evil Spirits)

**Misleads detection of etiology
and results in mismanagement**



Surgical instruments



Trephine operation

SOME IMPRESSIVE ACHIEVEMENTS THROUGH SEMIEMPIRICAL THINKING

1. Building pyramids
2. Moving heavy weight on wheels
3. Fermentation (wine and beer)
4. Tissue preservation (embalmmment)
5. Wheat storage (Prophet Youssef project)
6. Drugs from plant extracts

Mastaba

Saqqara
Step pyramid

Dahshur

Giza-Khufu

150 m

150 m

100 m

100 m

50 m

50 m

3000 BC

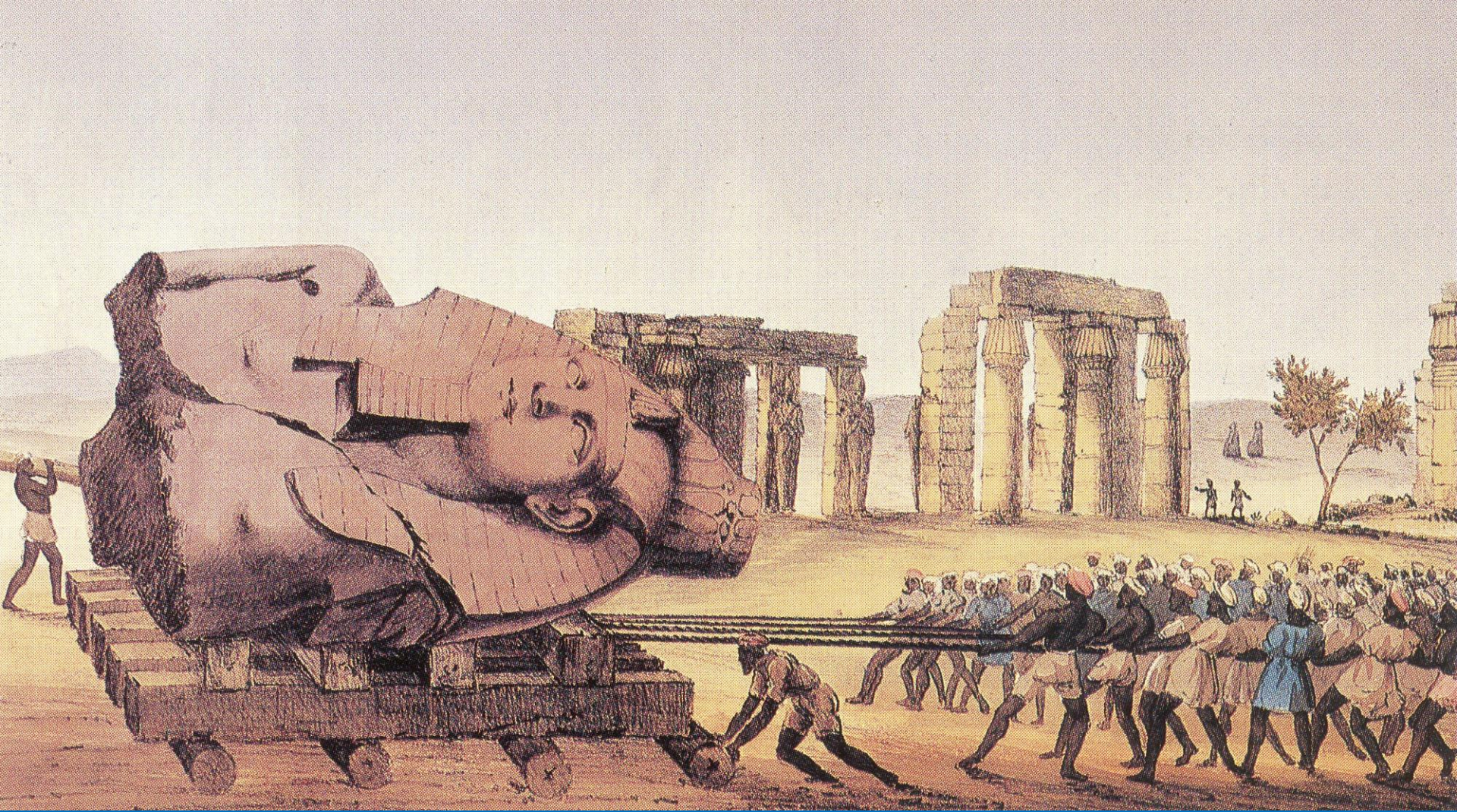
2670 BC

2589 BC

2566 BC

Building a perfect Pyramid

by trial and error over 434 years



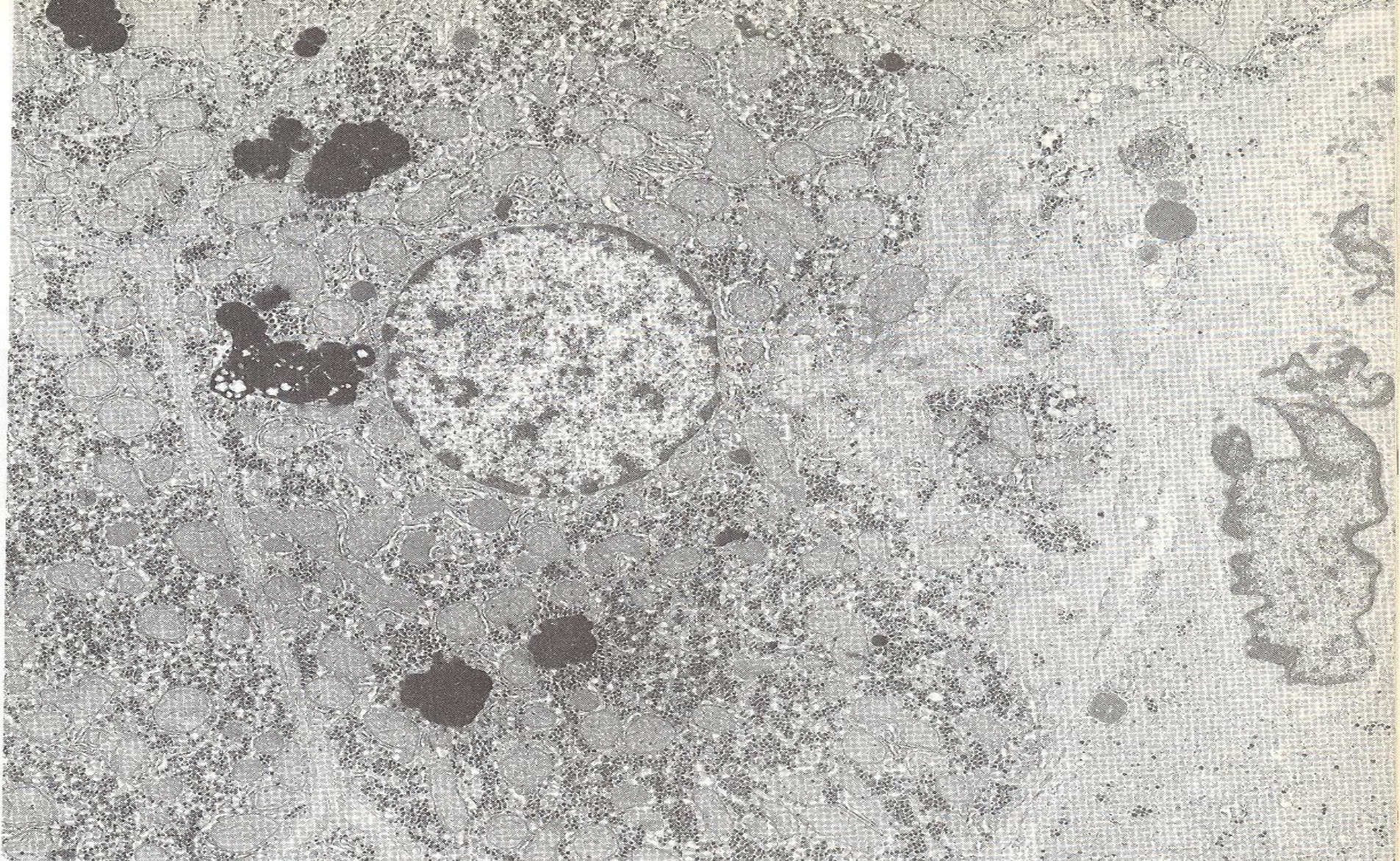
Moving heavy weight on wheels



Wine from grapes



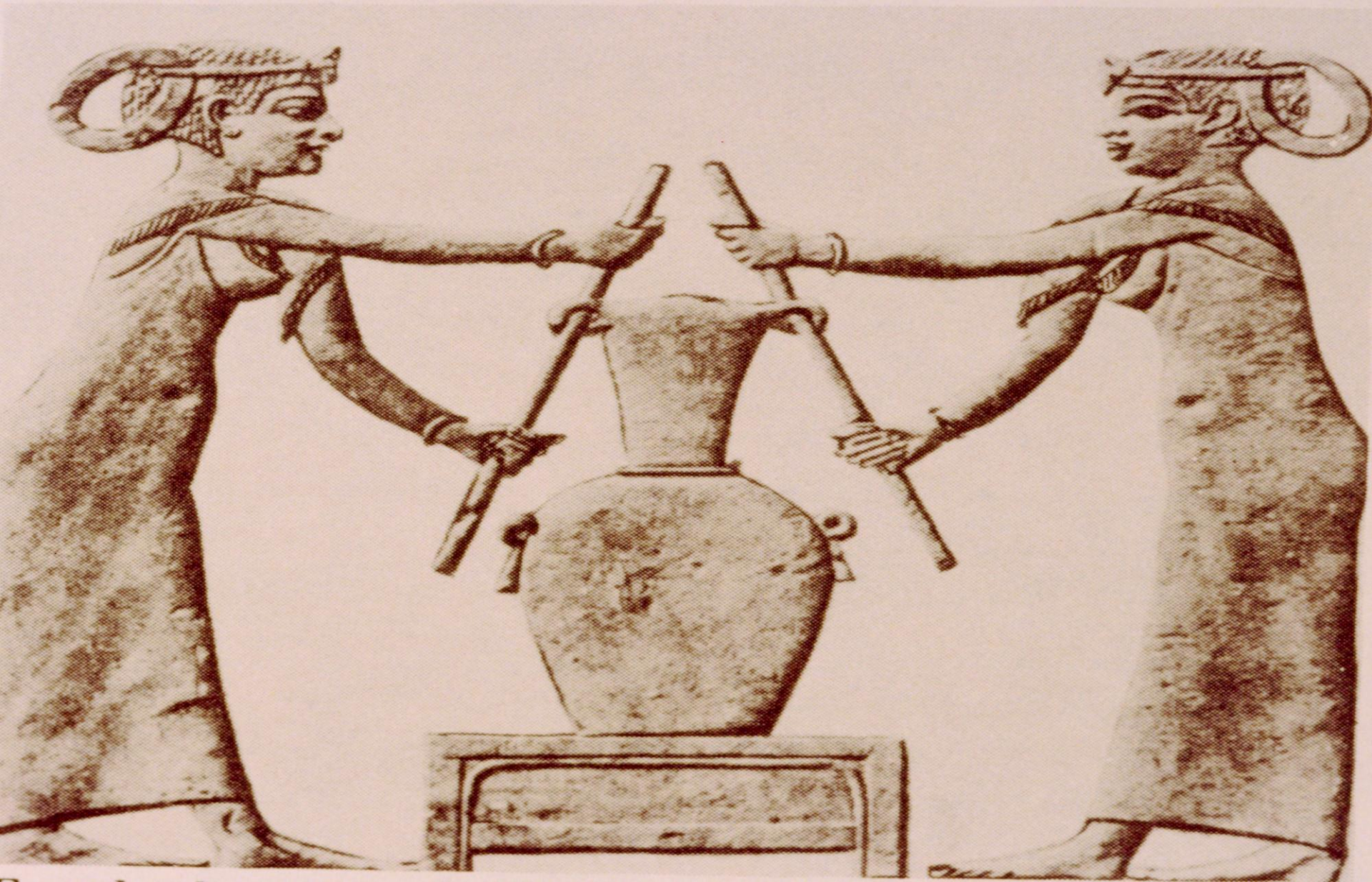
EMBALMING: 1. Fixation (Wine)
2. Dehydration (Dry Natron Salt)



EM of liver cell from a mummy



**Wheat Storage from 7 years of plenty
(Prophet Youssef Project)**



Drugs from plant extracts

ANCIENT GREECE



SUPERNATURAL VERSION OF ANCIENT GREEK

- 1. Only one dozen of Gods
in human forms**
- 2. Sleep and dream in temples
and get cured**





Heracles and The Centaur



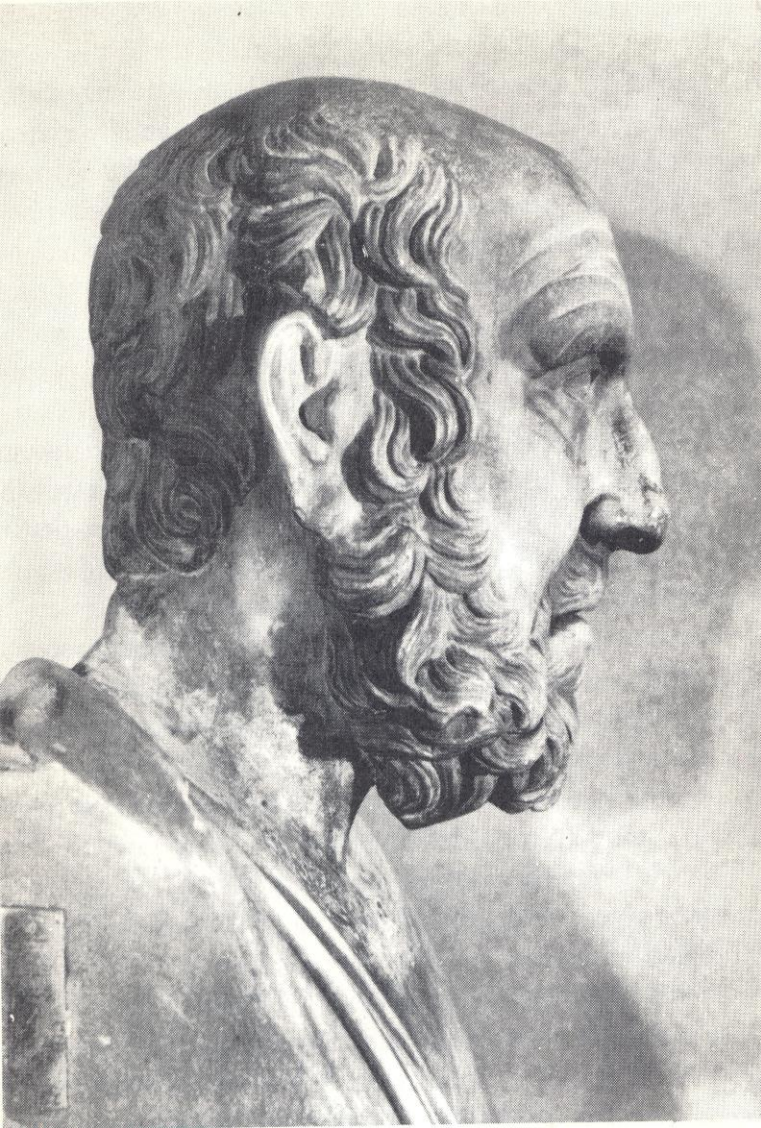
**Dream in temples and get well
through the help of Aesculapius**



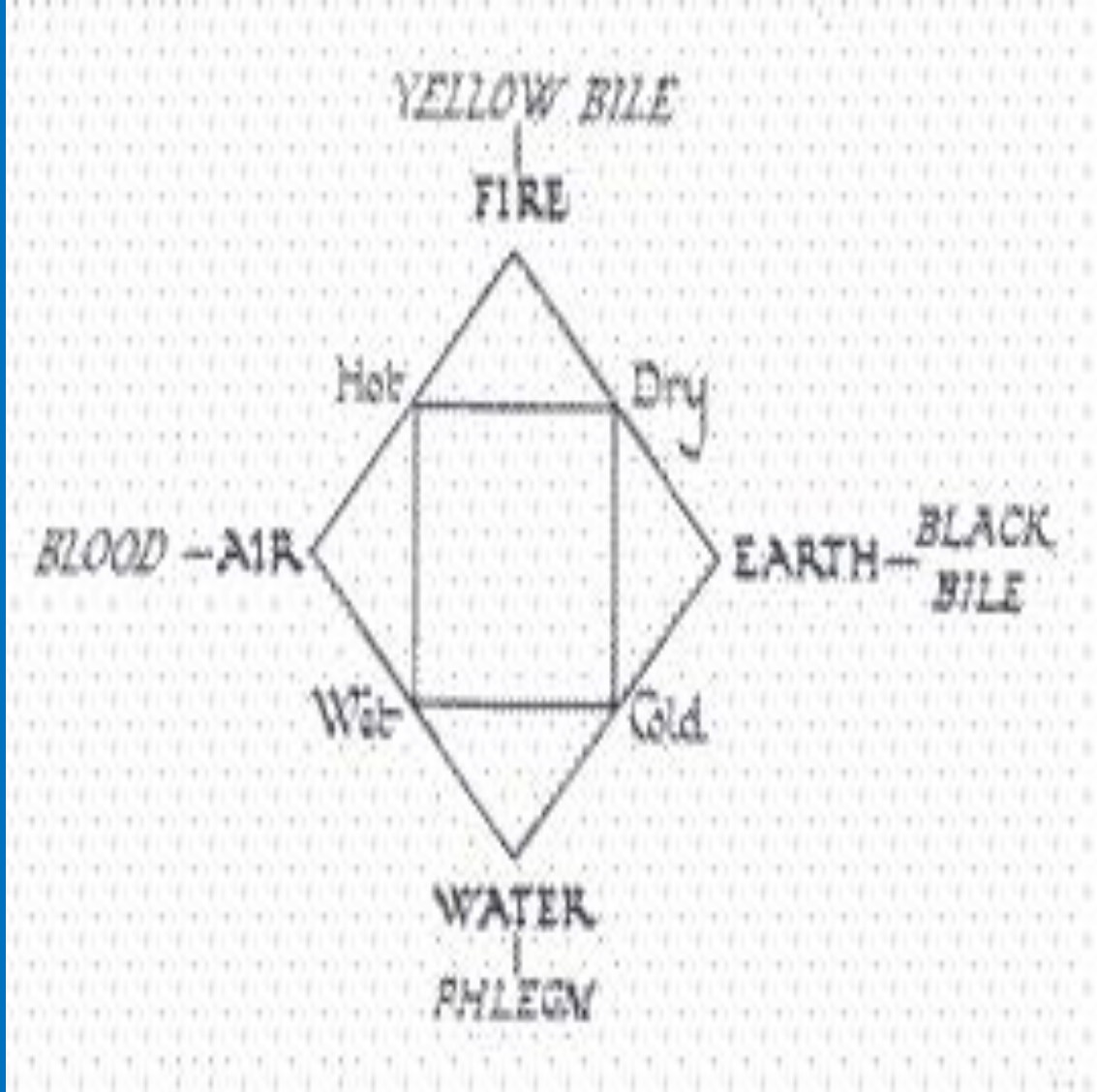
Greek philosophers in School of Athens

THE GREEK CONTRIBUTION TO SCIENCE

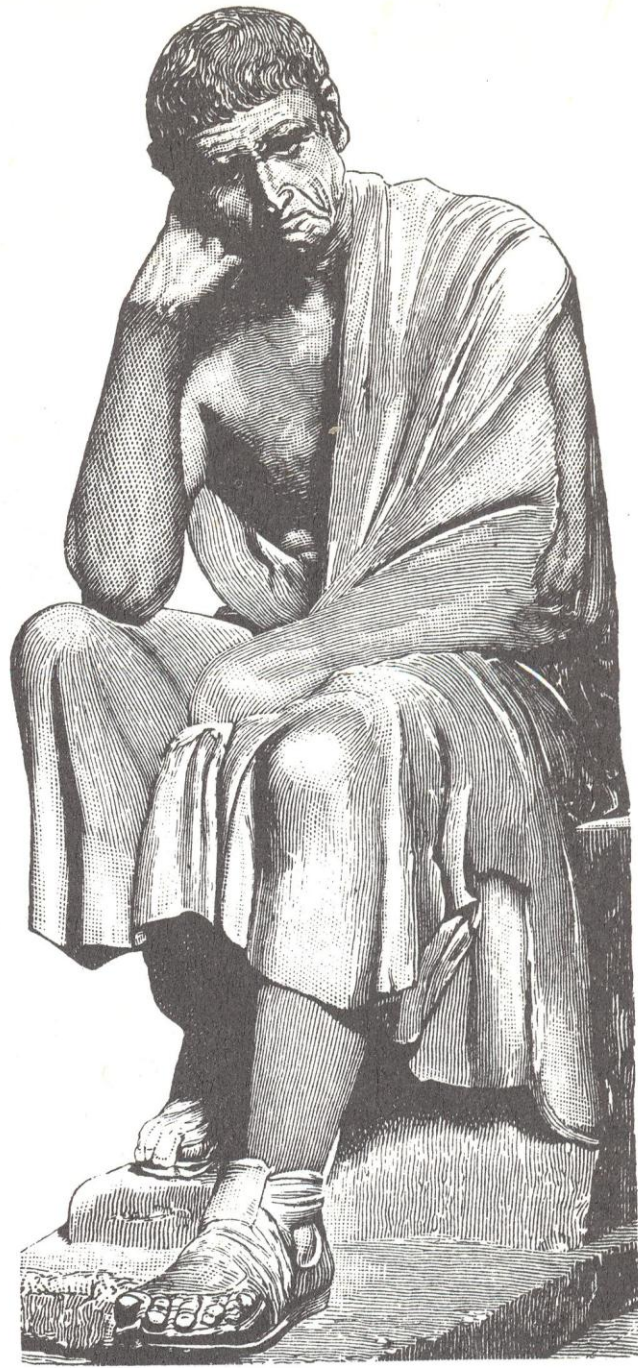
**“Natural rather than
supernatural concepts”**



**Hippocrates
(460 – 375 BC)**



The humoral Theory



Aristotle

(384 – 322 BC)

**The greatest
thinker
of all times**

CONTRIBUTION OF ARISTOTLE IN BIOLOGY

1. Taxonomy

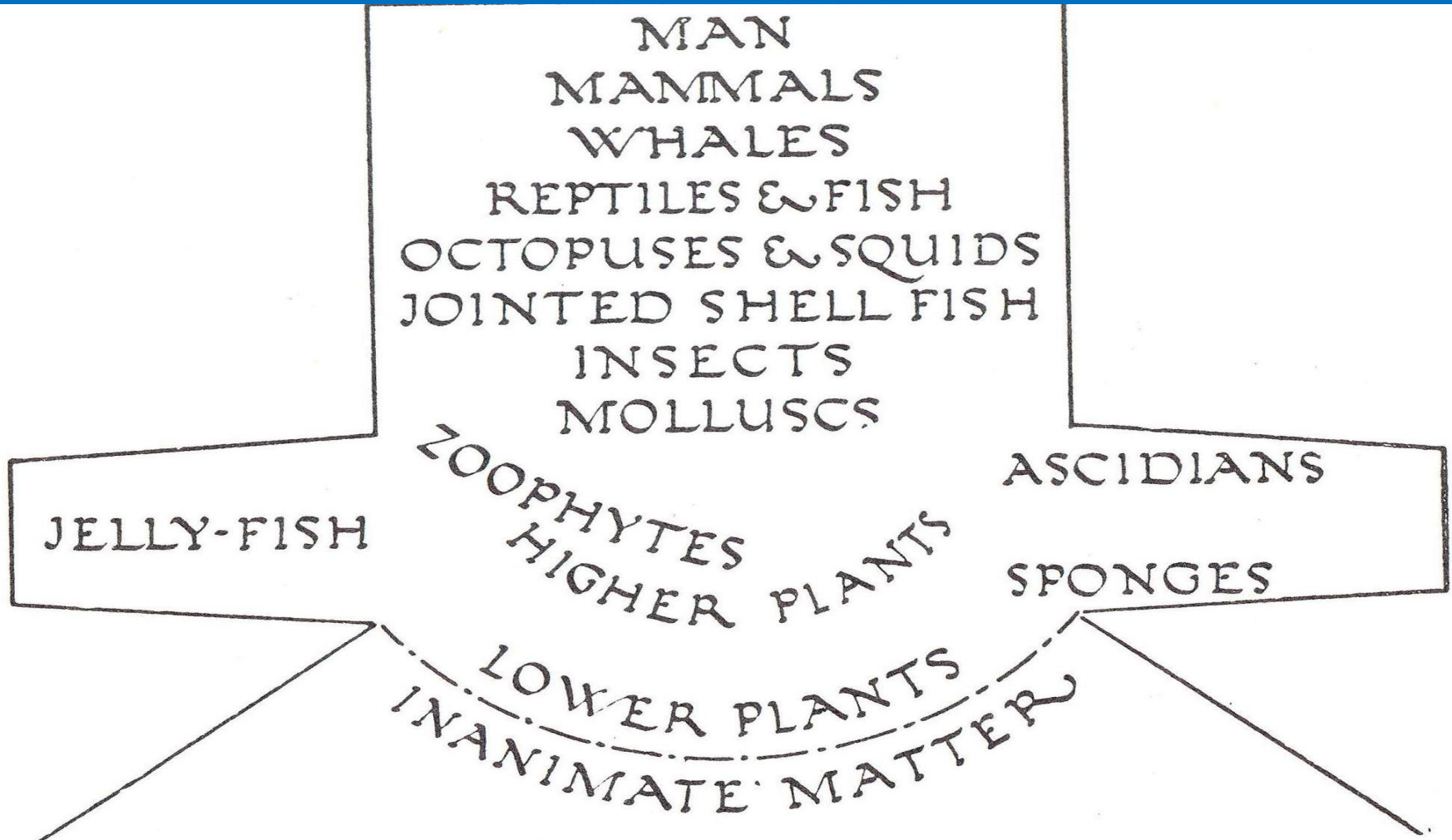
Classification of living organisms

2. Life Is the power of self nourishment

3. Soul 3 orders: lowest (vegetative), animal (sensitive) and highest (intellectual)

4. Man Is an animal at its highest level

ARISTOTLE LADDER OF NATURE



- Fixity of species and their arrangement in orders

CONTRIBUTION OF ARISTOTLE IN PHILOSOPHY

1. **Any problem** in nature or human behavior could be a subject of study (**Freedom of Thinking**)
2. **Logic** (علم المنطق) is to obtain knowledge through reasoning or posing statements (premises) which lead to a conclusion
3. **Validity** (مصادقية) is the extent to which a conclusion corresponds accurately to the real world

THE TWO TYPES PF REASONING

1. Deductive reasoning (استنتاجی)

Starts by a generalization (hypothesis) then reaches a specific conclusion

2. Inductive reasoning (استقرائی)

Starts by multiple observations then ends by a generalization (untested hypothesis) .
Example: Darwin theory of evolution,
(subject to revision)

A VALID CONCLUSION FROM DEDUCTIVE REASONING

All men are mortal *(Major Premise)*

Socrate is a man *(Minor Premise)*

Socrate will die *(Conclusion)*

INVALID CONCLUSION FROM DEDUCTIVE REASONING

Animals can live in Mars* (*Major Premise*)

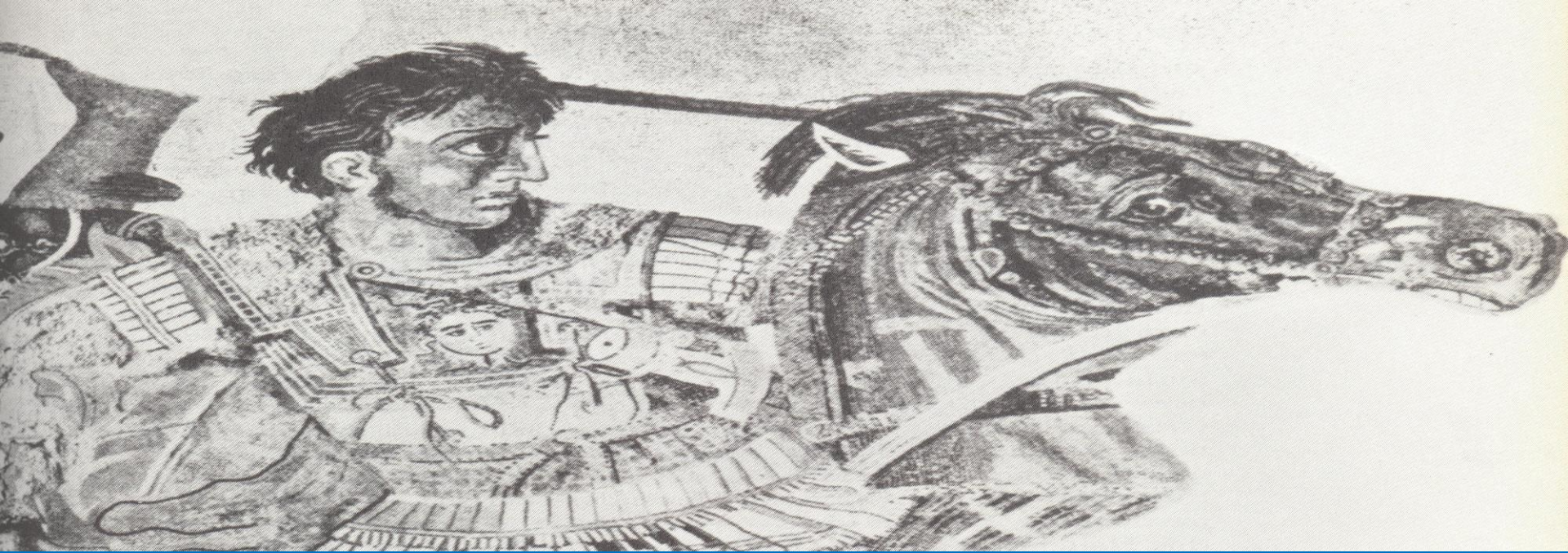
Humans are animals (*Minor Premise*)

Humans can live on Mars (**Conclusion**)

* A wrong premise

ALEXANDER THE STUDENT OF ARISTOTLE



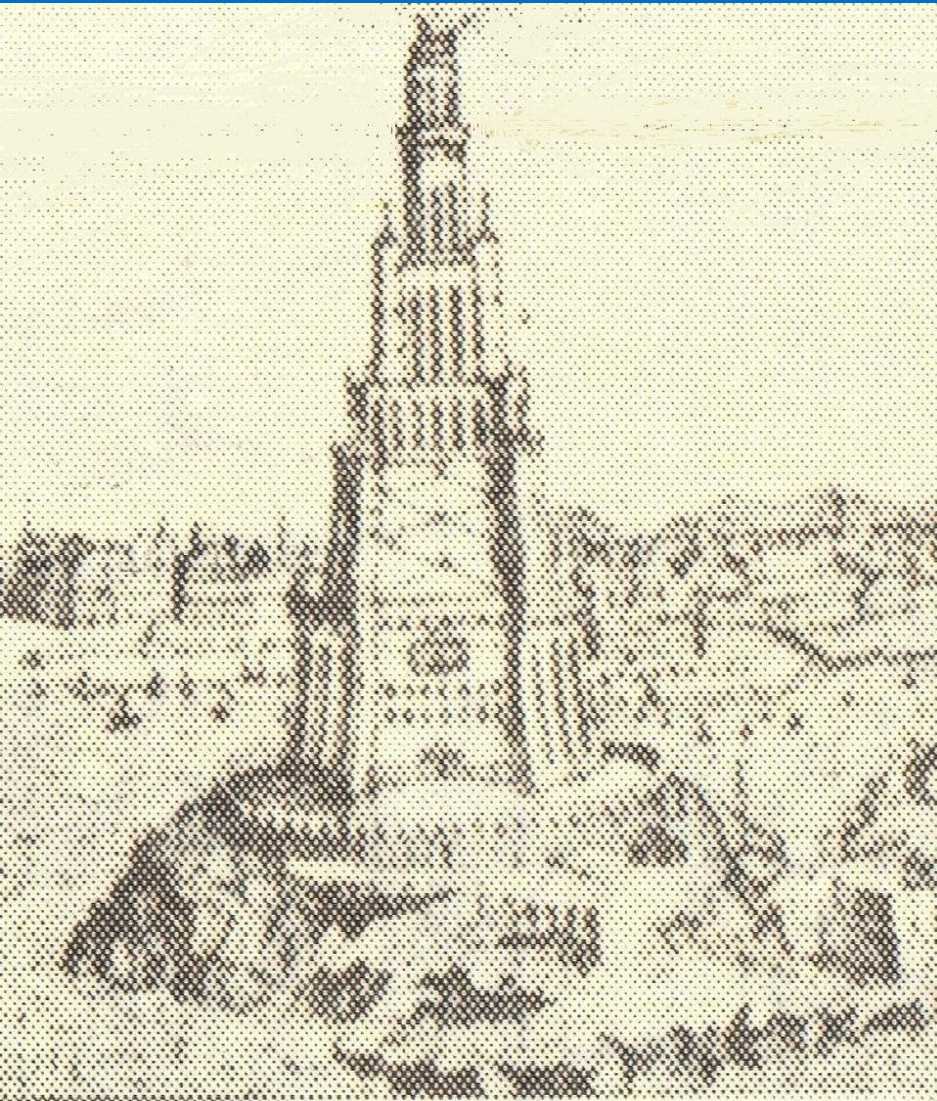


ALEXANDER EMPIRE (356 – 326 BC)



ALEXANDRIA LIBRARY

THE CAPITAL OF SCIENCE (283 BC)



THE AMBITIOUS PROJECT OF ALEXANDER THE GREAT

- **Theory**

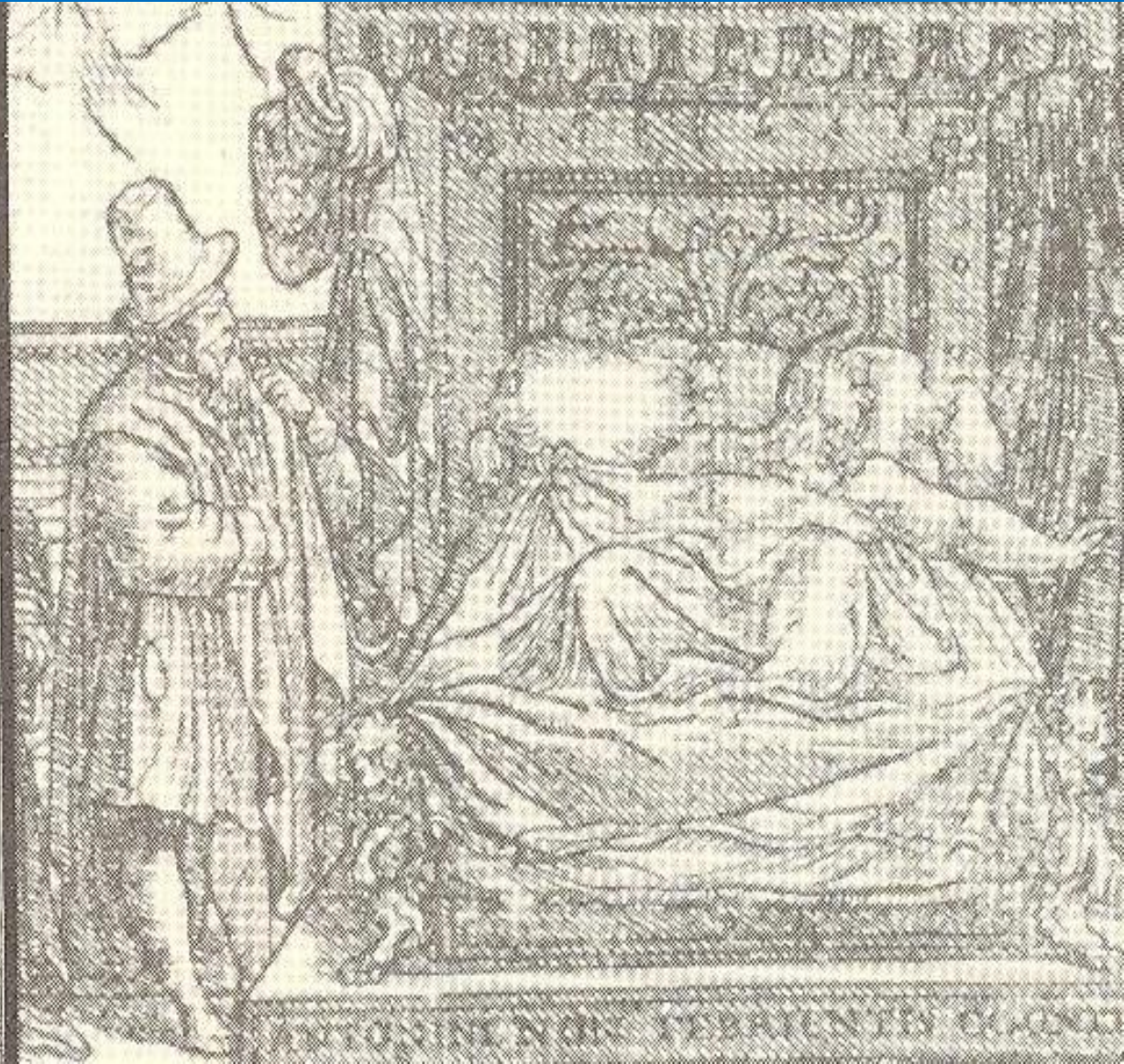
Greek culture is the only civilization,
other people are barbarian

- **Application**

Unification of nations under Greek
rule through military force and
intermarriage

CLARISSIMUS GALENUS (130-200 AD)

The top physician of the Roman Empire



PITFALLS OF THE INFALLIABLE GALEN

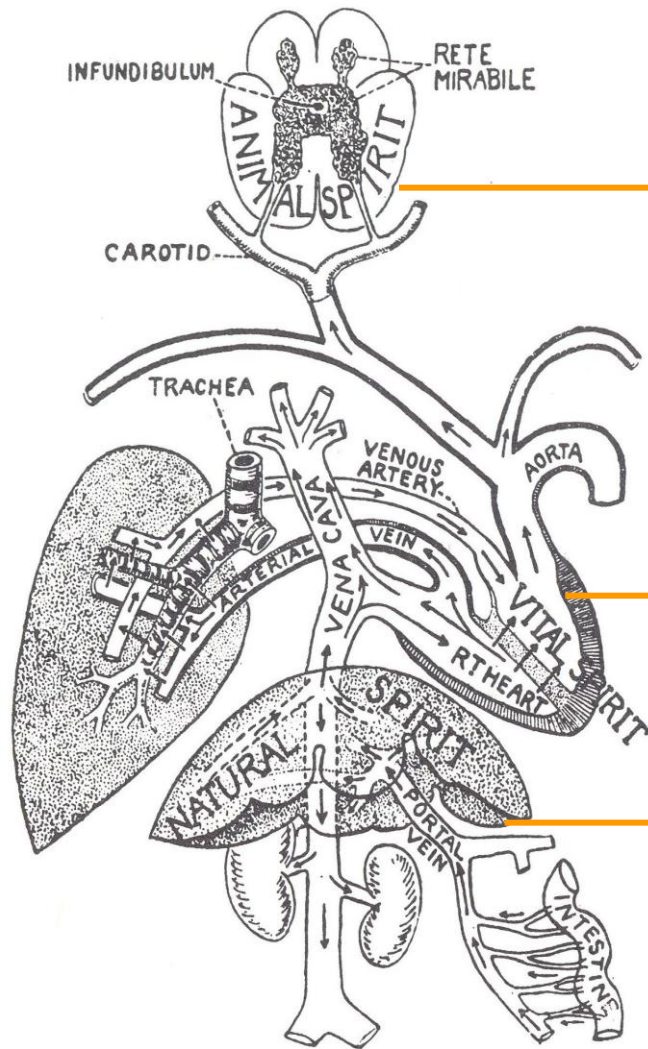
- 1. Correction of humeral imbalance by cautery and venesection**
- 2. The three spirits of the body**
- 3. Applying animal anatomy to humans**

CAUTERY AND VENESECTION

To correct humeral imbalance



GALEN THREE SPIRITS

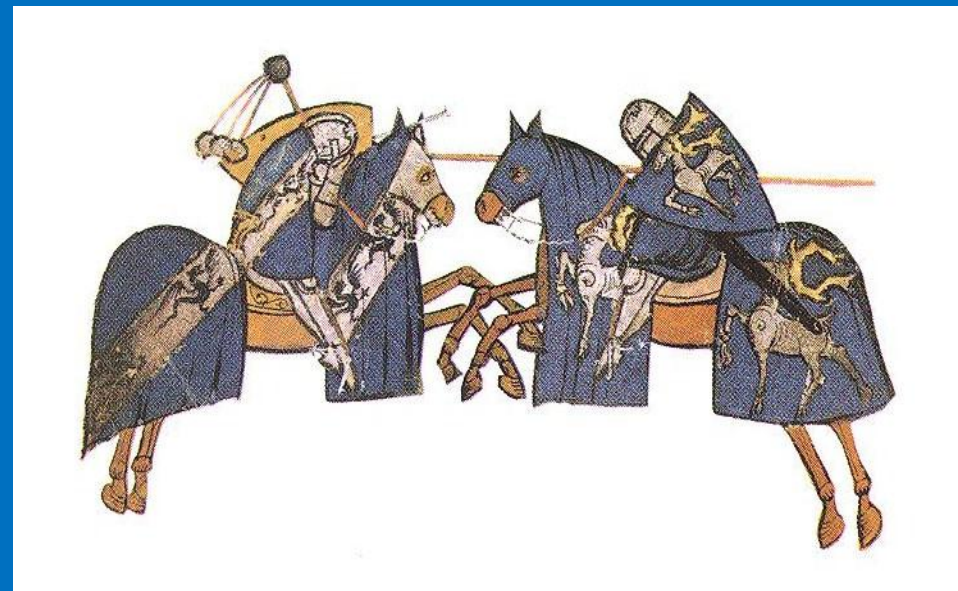
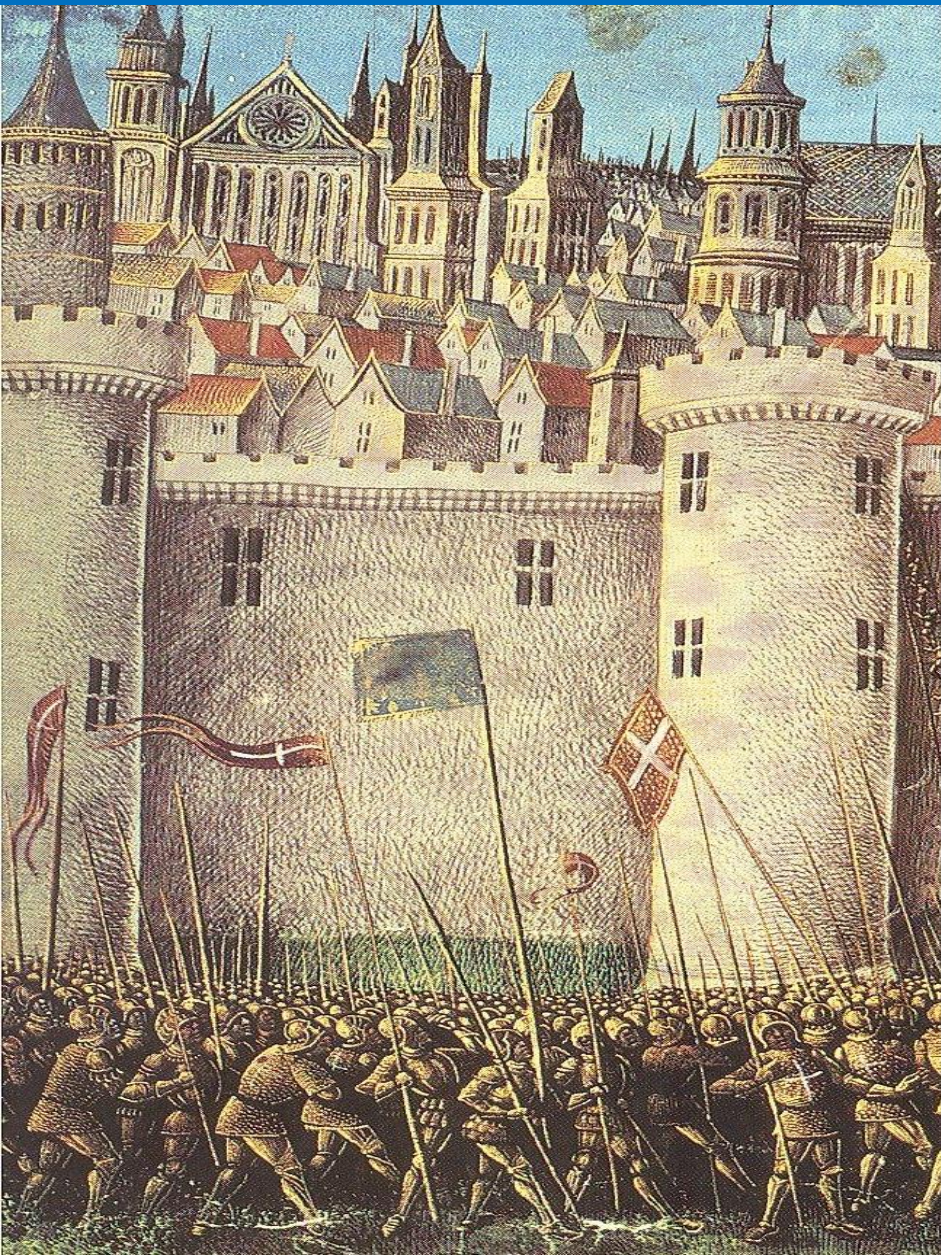


Animal Spirit

Vital Spirit

Natural Spirit

MEDIEVAL EUROPE (200 – 1500 AD)



MEDIEVAL LIFE (THE DARK AGES)

Special Features

- 1. Dominance of church**
- 2. Wars**
- 3. Epidemics**
- 4. Stagnation of science**



SAINT AUGUSTINE (354 – 430 AD)

Dictates his book City of God (410 AD)

AUGUSTINE DOCTRINE (THEOLOGY)

- 1. The church above the state**
- 2. Faith above knowledge**
- 3. Disease is a punishment from God**
- 4. No salvation of sins or disease outside the church**
- 5. Divine concepts of the church about religion or nature must be obeyed**
- 6. Any one who disobeys is considered heretic and executed**

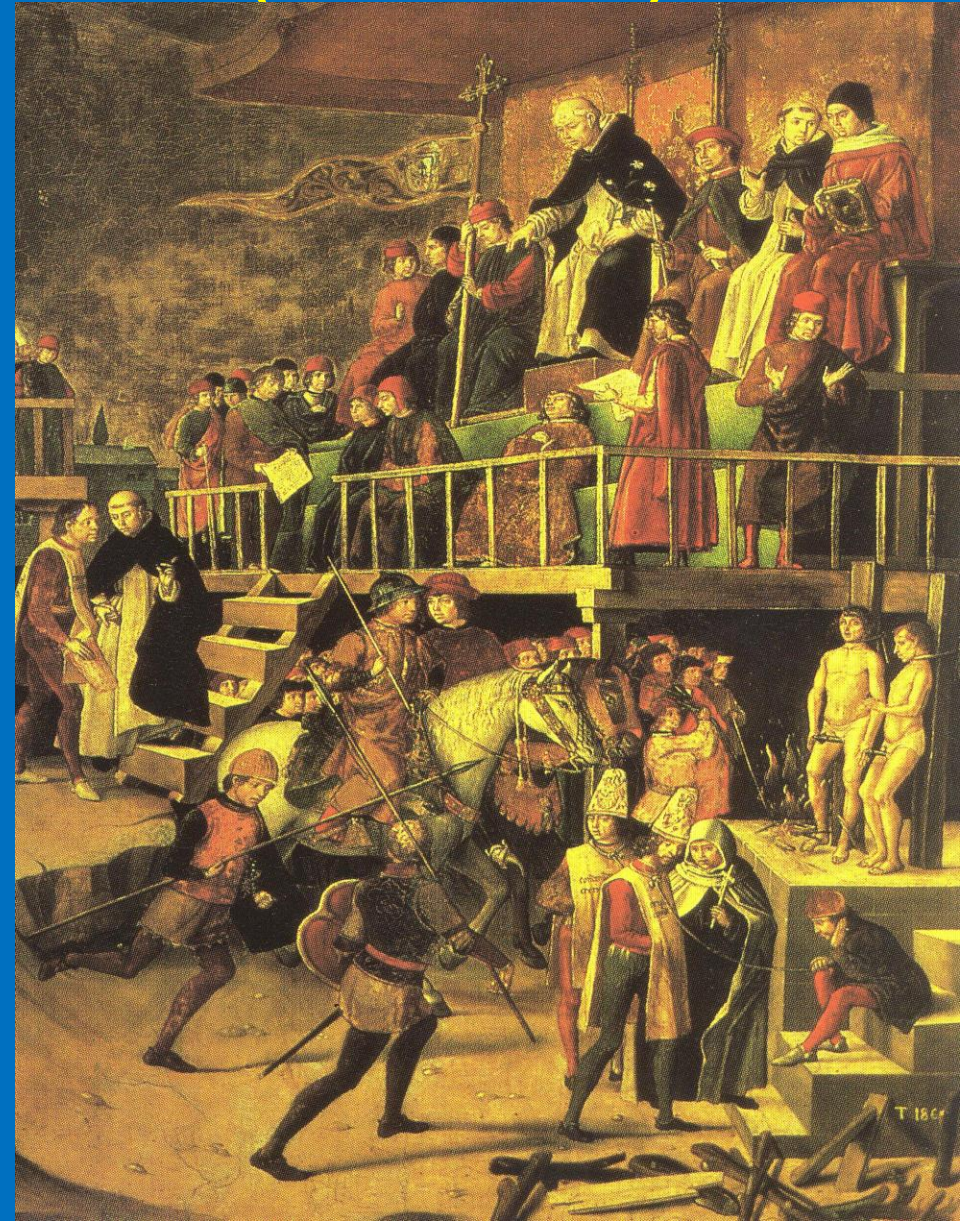
HERETICS

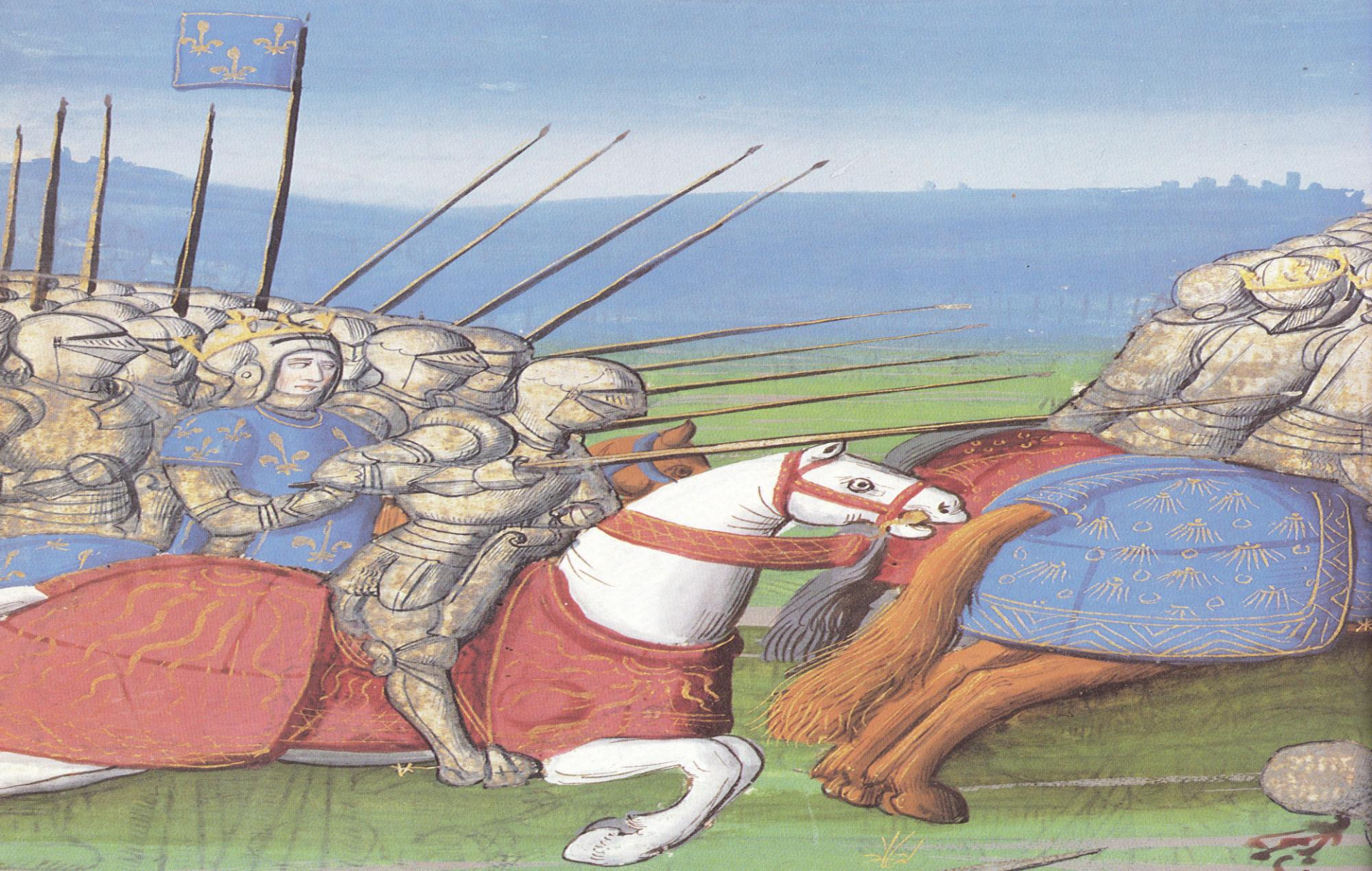
(المرتدين)



INQUISITION

(محاكمة متعسفه)

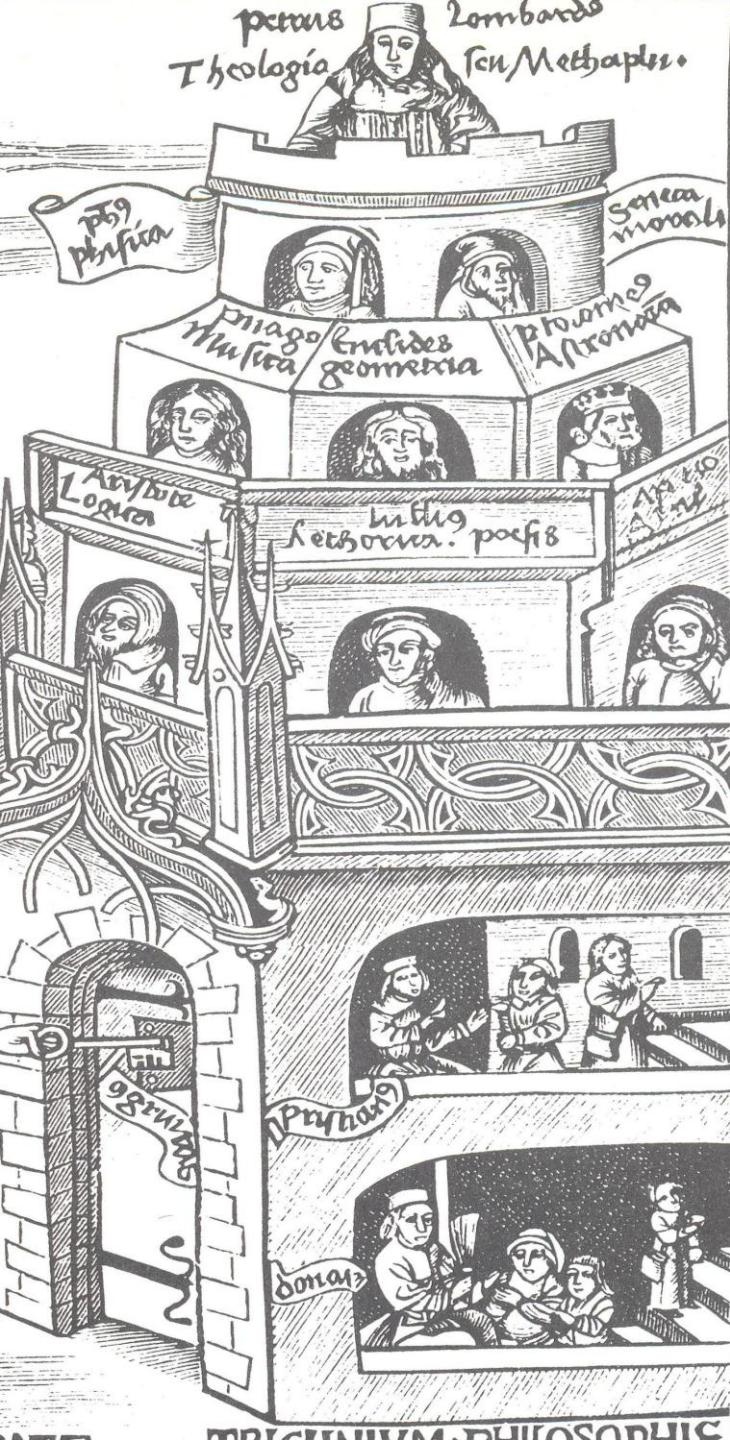




WARS

The Crusades (1095 – 1281 AD)

The 100 years war (1339 – 1558 AD)



- Theology is the Queen of all sciences
- The church prescribes faith to patients
- Surgery and medicine are subspecialties of church



**The Miracle of Saint
Cosmas and Domitian (300 AD)**



- The Virgin crowns a crusader
- The child cures syphilitic patients



**Plague
Black Death**



THE CHURCH CONFRONTS PLAGUE

A Medical Fiasco

1. More prays to God
2. Killing Jews, dogs and cats
3. Flagellation
4. Fumigation of streets
5. Protective leather clothes

laingune tuo. proprio ne met
num uascaris nobis. Act.



THE CONFLICTING THEORIES ABOUT THE UNIVERSE

1. The geocentric model (Ancient Greek and catholic church)

The earth is the center of universe, the sun and planets rotate around

1. The heliocentric model (Copernicus)

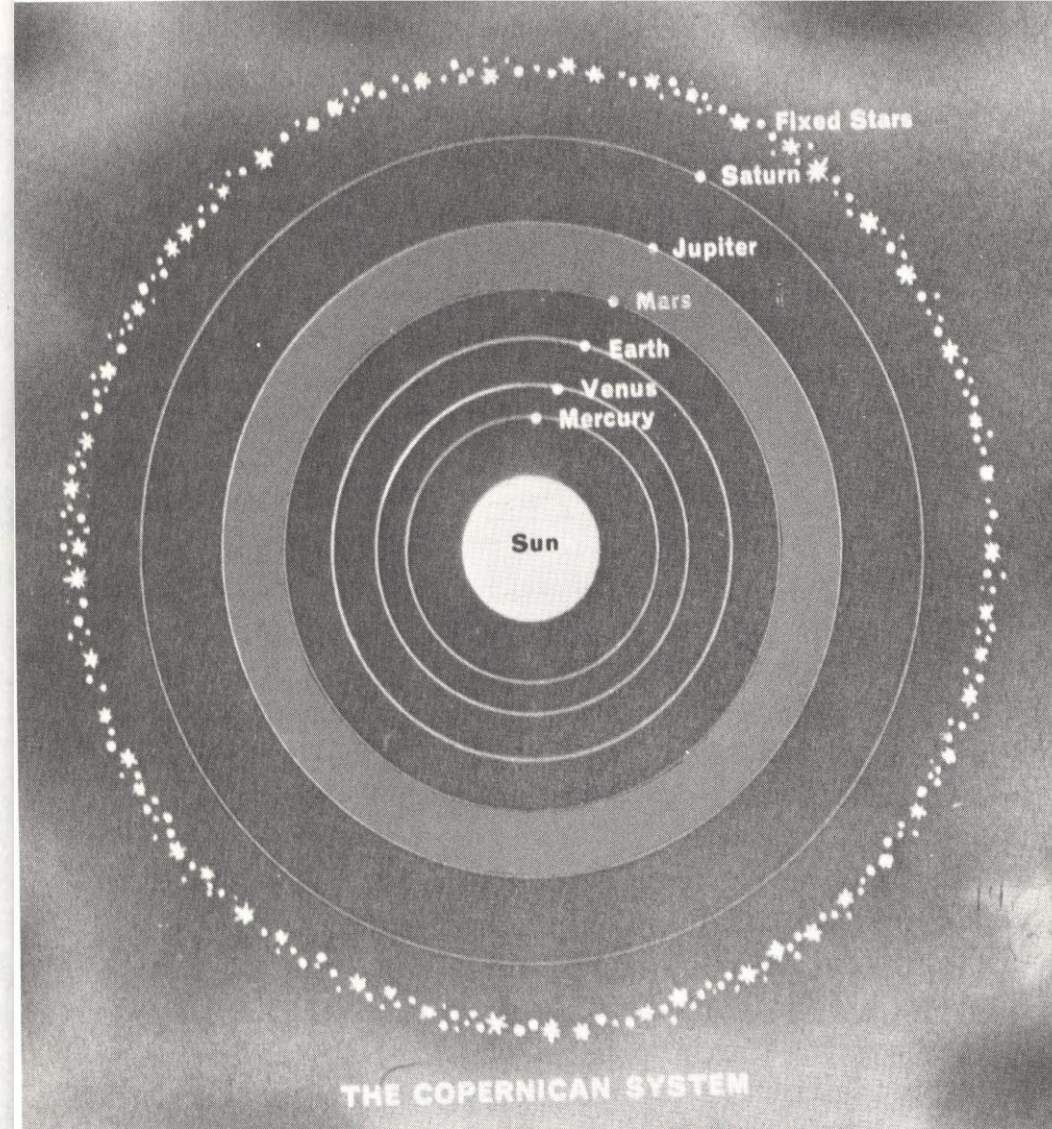
The sun is the center of universe, the earth and planets rotate around.

GEOCENTRIC THEORY

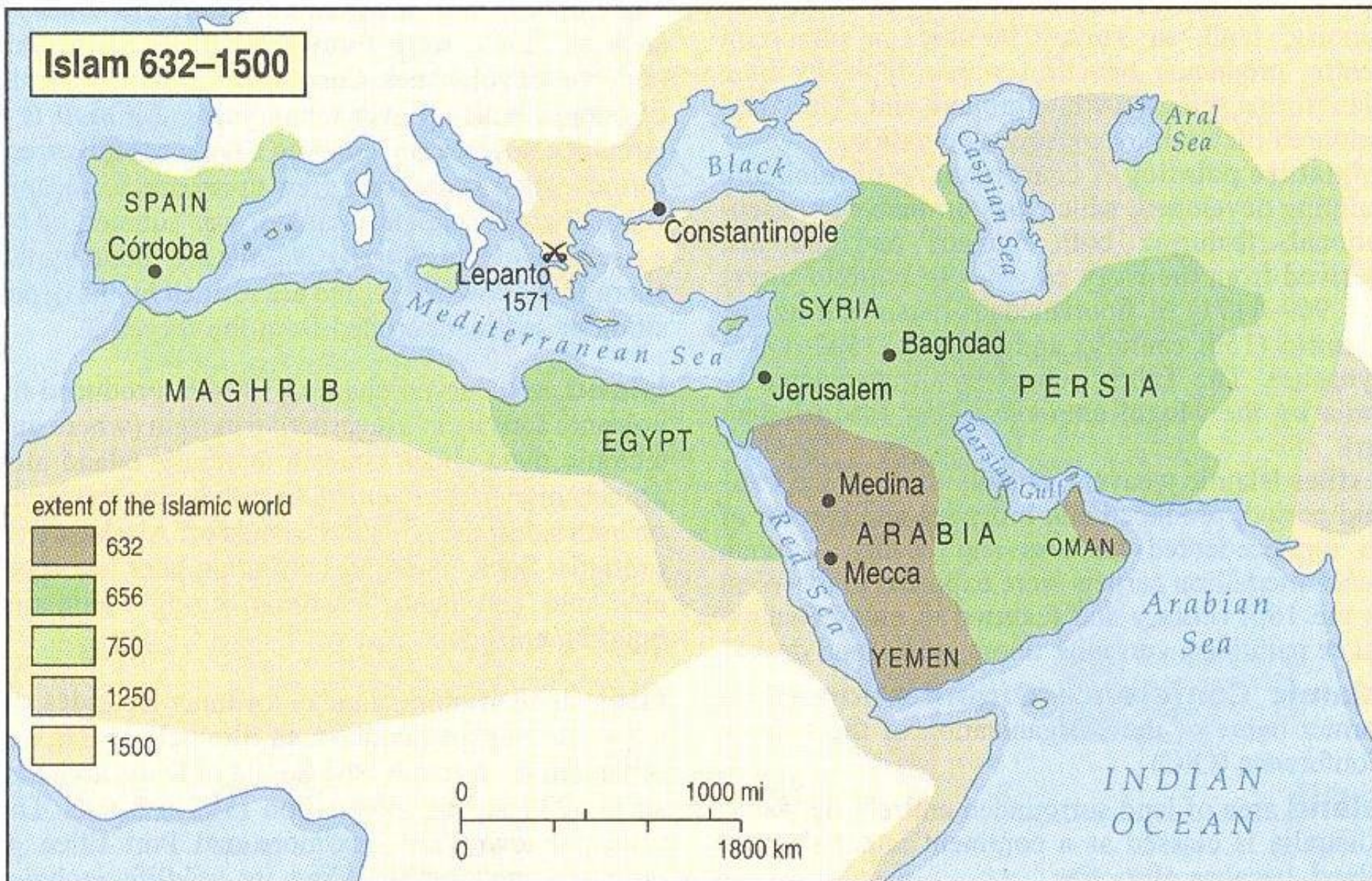


NICOLAUS COPERNICUS THEORY (1473 – 1543)

HELIOCENTRIC



THE ISLAMIC EMPIRE (900 – 1200 AD)



CONTRIBUTION OF ARABS TO WESTERN CIVILIZATION

1. **Chemistry** (Al-Razi, 865 – 925 AD)
2. **Medicine** (Ebn-Sina, 980 – 1037 AD)
3. **Surgery** (Al-Zahraw, 940 – 1039 AD)
4. **Optics and Scientific method**
(Al-Hytham, 965 – 1040 AD)
1. **Translation** to Latin of Greek works
(Ben-Salim, 1282 AD)



AL-Zahrawi (940 – 1039 AD)
The father of surgery

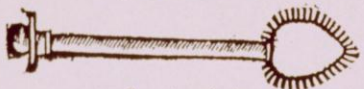
Albucaasis

& conuersatus est in dispensibus suis. & non fecit ei frictat in
 ambulacione hoc uenit oino. **Et ad os emineo in lo-**
 co corporis iam fractu est: tunc opus est ferre ipm fm hunc
 modum: & ut aclytas ligamētis stringe ipm in extrema
 te ossis emineat: p̄cipe alit q̄ extēdat ipm ad sursum: &
 pone ligamētū aliud ex lana grossi? ligamēto f. Deinde li-
 ga ipm sup carne q̄ est sub ossis: extēde extremitatē eius ut
 trabas carnē ad inferiōrē: tu de te q̄ carnē sup locū quez
 vis serrare: p̄ nō ledat terra carnē: pone lignū aut tabulam
 sub ossē: tunc decēter: q̄m quī facit illdōn p̄hibet qn̄ secat
 carnē corruptā. Et opus est serratura sup locū corruptum
 parū perit nō sit locū tate ossis corruptior: nō apparet
 in apparitibz huc sensu: ut cogat ad serraturā sal vice alia.
Et si os est corruptū & nō est emineo: ut p̄tinuat pars
 ei? cū p̄ter corruptū ē in medio ei? aut in gre iph? tūc de-
 tege eā nō ab ossis p̄tib? totā. Deinde pone lignū inferi?
 Postea terra illud ex p̄te p̄ vbi ē corruptio: donec p̄tinet
 serratura ex p̄te altera: & sit serratura fm lōgitudine a cor-
 ruptioe parū perit q̄m q̄ vltimū. **Et si corruptio est in**
 lūctura: in dē ipsam lūcturā corruptā & terra nō vbi cōi-
 muat ex p̄te altera. Si nō corruptio est in p̄tinuatiōe: ut ap-
 paret: tūc nō est in ea lignū nisi abiatō. **Et si cor-**
 ruptio est in pectine manus: aut in pectine pedis: tūc res in
 eo est difficilis valde. **Et opus est inquirat corruptioe ill-**
 ter apparere tibi. Et ab iudicā eam: & mūdē ipas fm quā-
 citq̄ dispositionē tibi potest esse: tū quocūq̄ ingenio recti-
 ficat tibi: q̄m non facit tibi frictat veniat neruus. **Et**
 si os q̄ lūctosus: & terra ad incidendū ista ossa sunt multat
 fm lūctū ossium: & preparatiōe eoz & ipoz grossitudinē
 subtilitatem eoz: & magnitudinē parulitatē ipoz: & eu-
 rielon ipoz: & eorum raritatem. Quapropter opus est pre-
 parare omni spe del operatiōis instrumentū: & uenire ad illā
 operatiōē. **Et scias q̄ operatiōe iste significat tibi su-**
 per specie instrumentū quo iudicēs quādo tecū est studium
 longum. Et cognitiō modoz buluz artio testimonū mo-
 doz: & lūctū: tūc enim iam inuenies per reipm illud
 quod conuenit ei et instrumentū ad eam infirmitatē. Et ego
 sum firmans tibi in ultimo buluz capituli nūm q̄ in illo op
 que p̄nce et exempla super que incidēs. & probatiōem qua
 expertario super illa.

forma serrae



forma alterius ferre



forma ferre alterius



forma ferre alterius

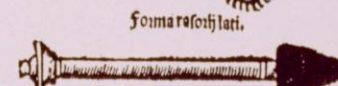


Est caput buluz rasoij: fm formam capitis clauis stellaris
 & puncta eius sit fm formam puncta op̄ elis: & herbi. Et non
 conuenit nisi ut fricentur cum eo capita lūctura: q̄m cor-
 rumpantur aut os anipulum magnum.

forma maioris rasoij



forma maiore dii rasoij

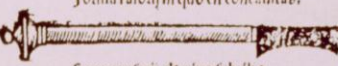


forma rasoij lati

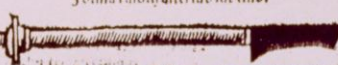


Hec forma ferre depleta sit decēter facta. fiat atque eius su-
 perior: & acuitas duo ex ferroz: manubii eius ex bulso:
 & pyramidale decēter factum.

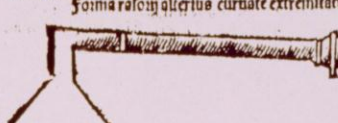
forma rasoij in quo est concavitas



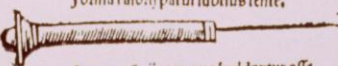
forma rasoij alterius subtilis



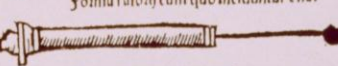
forma rasoij alterius curuante extremitate



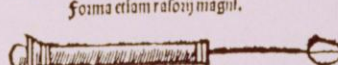
forma rasoij parul subtilis tente



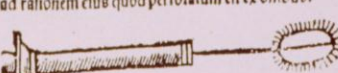
forma rasoij cum quo inclinat ossa



forma etiam rasoij magni



Hoc simillat radiōz extremitas est sicut terra: et herbi in
 locis multis ex ratiōe ossium. forma rasoij q̄ conuenit
 ad ratiōem eius quod perforatum est ex ossibus.



extremitas





**AL-Hassan Ibn Al-Haytham
(965 – 1040 AD)**

CONTRIBUTIONS OF IBN AL-HYTHAM

1. Optics

Linear path of light, reflection, refraction, anatomy of eye and mechanism of vision

2. Scientific methodology

600 years before the scientific revolution



Faraj Ben Salim (1282 AD) translated Greek and Arab works into Latin and introduced them to Europe



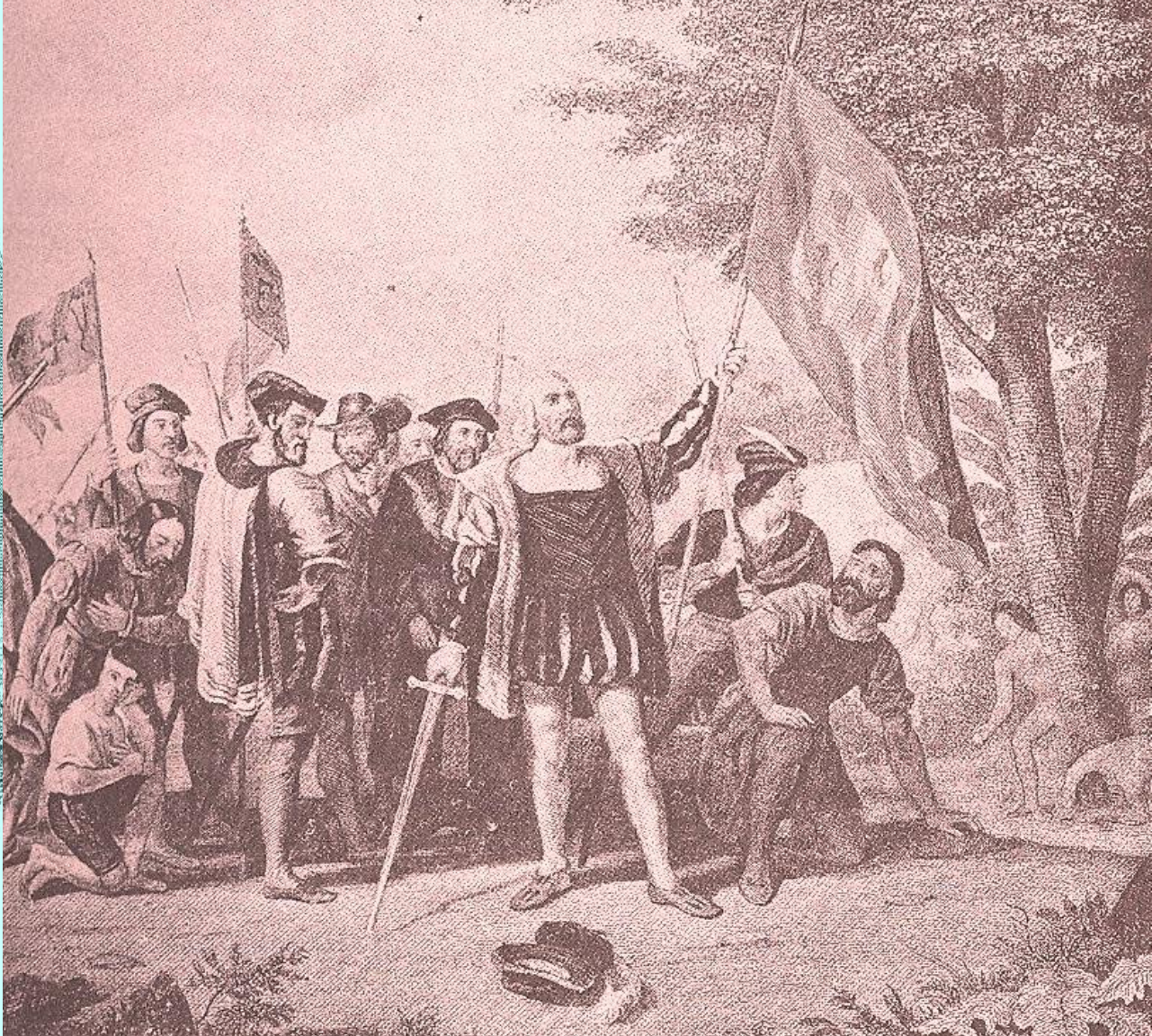
**The three historic authorities of
middle age**

RENAISSANCE EUROPE

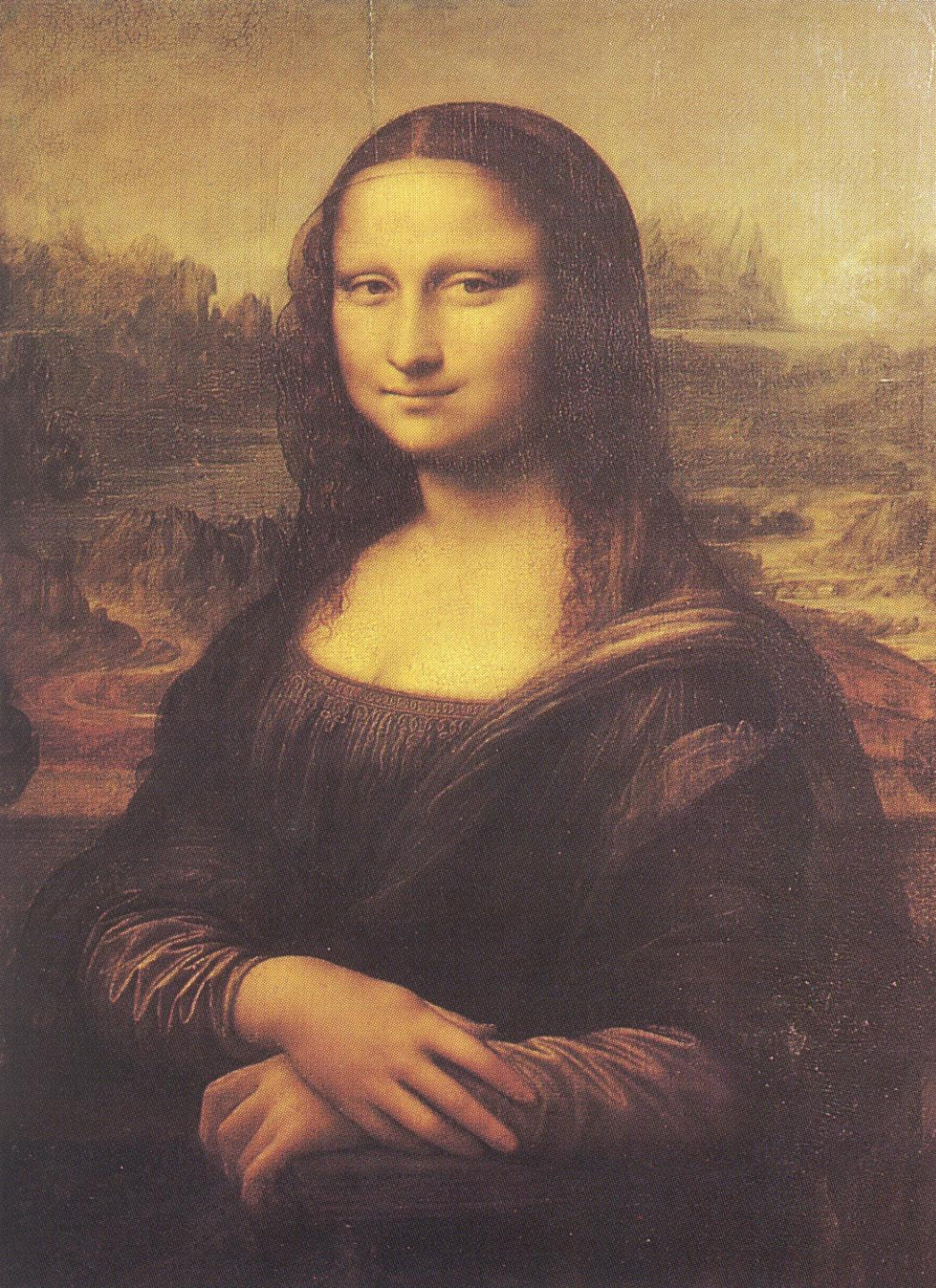
THE REVIVAL OF LEARNING

(1500 – 1600 AD)

- 1. Adventure and geographic discoveries**
- 2. New ideas in science and arts**
- 3. Corrections of historic works of Greeks and Arabs**
- 4. Invention of printing machine**



The landing of Columbus on the New World (1492 AD)



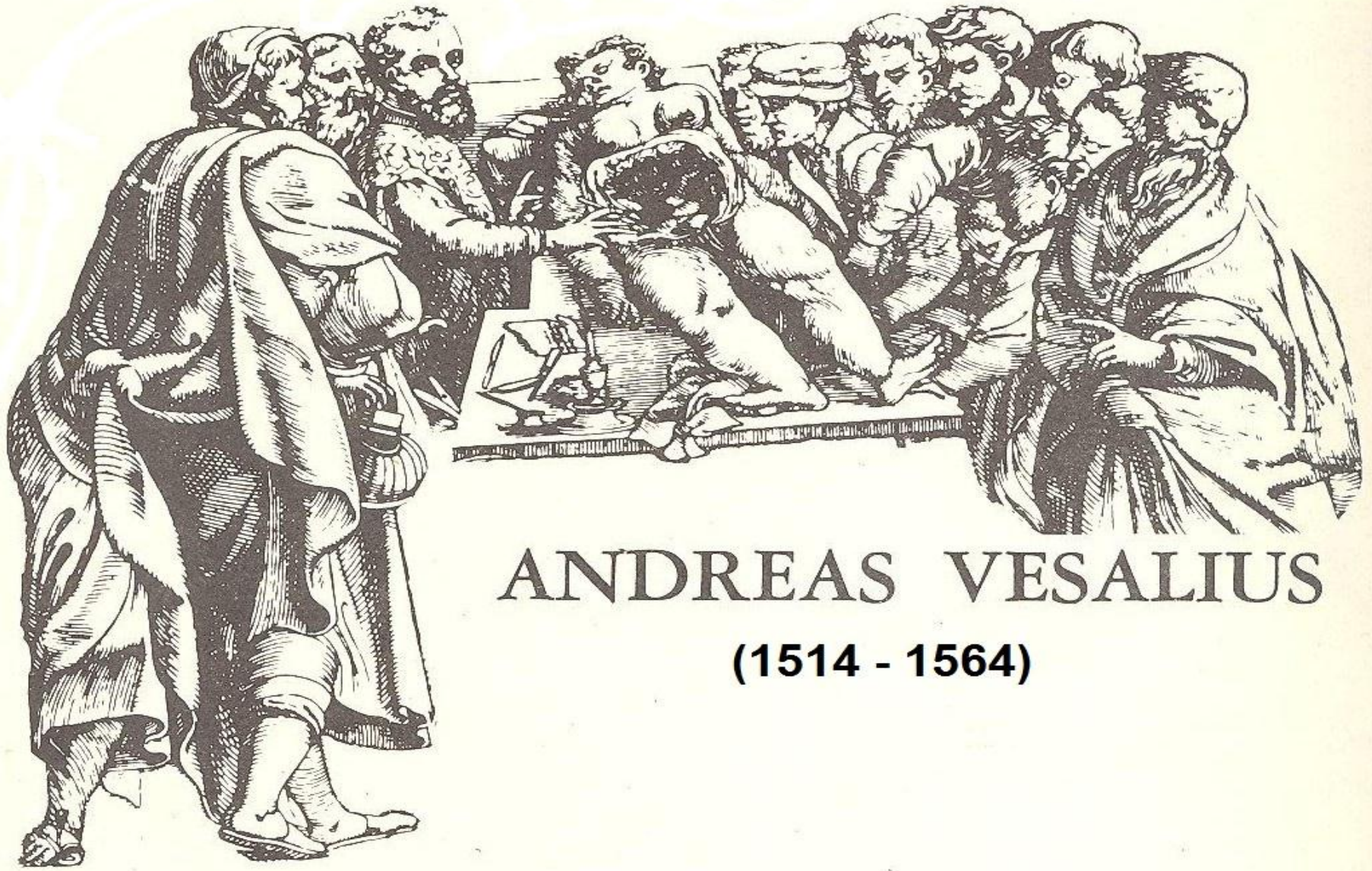
**DE VINCHI,
Mona Liza**

**Michelangelo,
The creation of man**





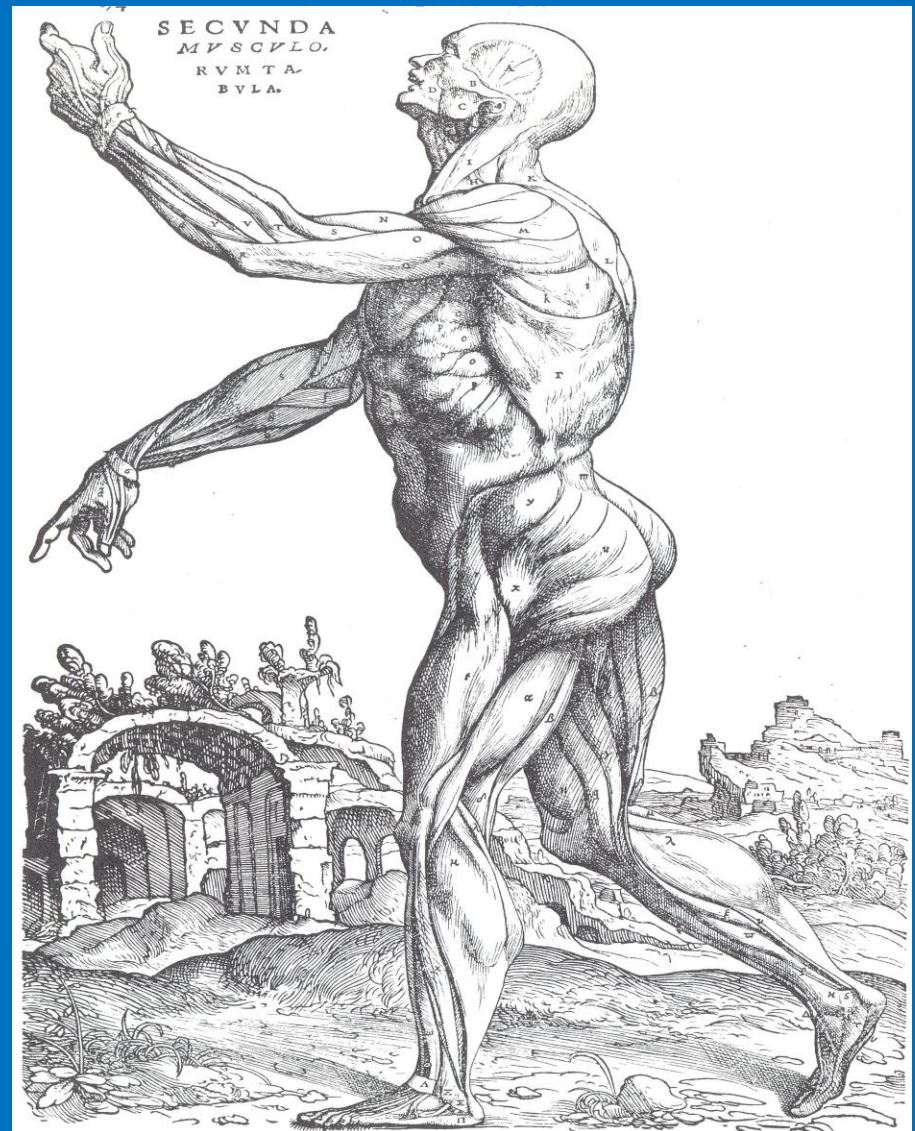
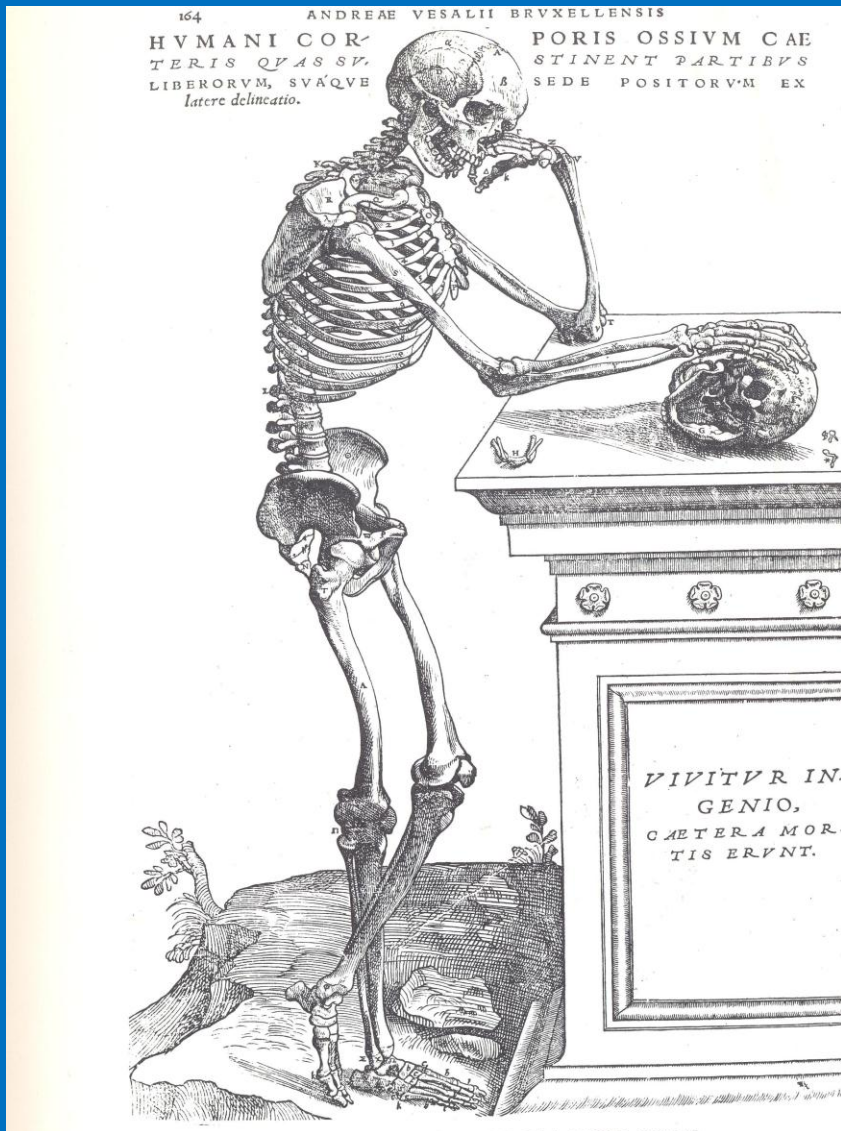
**Raphael,
Madonna**



ANDREAS VESALIUS

(1514 - 1564)

Correction of human anatomy



De Humani Corporis Fabrica,
(A. Vesalius, 1543)



Vras firus natione antio-
 occulis ante iudic. disci-
 pulus apolloz. postea
 pauli secus usq; ad con-
 fessione d' scruens dno sine crimine:
 nam neq; usorem unq; habuit neq; fi-
 lio: septua ginta et quatuor annoru
 obiit in bythinia. plet' spiritu sancto.
 Qui cu iam scripta essent euagelia. p
 mathru quide in iudra. p marcū autē
 in italia: sancto instigante spiritu in
 adhaie paribz hie scipie euangelii:
 significans etiā ipse in principio ante
 sui alia esse descripta. Qui cetera ea q
 ordo euagelia dispositionis reposita
 ra maxime necessitas laboris fuit: ut
 primū grecis fidelibz omni spherati-
 one ueniret in carne dei cristi manife-
 stata humanitate ne iudaicis fabulis
 areni: in solo legis desiderio tene-
 tur: uel ne hereticis fabulis et stultis
 sollicitationibz seducti reciderent a ue-
 ritate laboraret: dehinc. ut in prin-
 cipio euangelij id hānis natiuitate pre-
 sumpta. cui euangelium sembrat et in
 quo elect' scriberet indicaret: cōstās i
 se cōpleta esse. q̄ essent ab alijs inctpa-
 ra. Qui ideo post baptismū filij dei a
 pte dione generatiōis i cristo imple-
 re: pte dione uacuitatis huma-
 ne potestas pmissa ē: ut requirentibz
 demonstraret in quo apprehendēs e-
 rar per nachan filiu dauid in cristo re-
 currentis i dno generatiōis admissio-
 indisparabilis in pōicās in homini-
 bus cristū suū. pte dione opus hois redire
 in se p filiu faceret: qui per dauid patē
 ueritatibus in pbebat in cristo. Qui
 hure non inuenit etiā scribendorum
 aduū apolloz potestas i ministerio
 datur: ut dno in dno pte dione re filio pōi-
 tionis regnādo. oratione ab apolloz

facta. forte domini electionis numerus
 compleretur: sicq; paulus consumma-
 tionē apolloz actibz dare. que diu
 cōtra stumulu realiterantē dno elegit.
 Quod et legentibz ac requirentibz
 deū. et si per singula repediti a nobis
 uale furtat: sacris tamē op opōratu
 agricolā opōreat de suis fructibus e-
 det. uirum? publica curiositatem:
 ne nō cā uolentibz deū dēstrare uide-
 rentur. quā salubritatibus prodidisse.

Quius prologus
 Quia quidē multi co-
 non hie ordinare nar-
 rationes q̄ i nobis com-
 plete sūt rex. sicut tradi-
 brūt nobis q̄ ab inicio
 ipi uiderūt. et ministri
 Brevit' tmonis: uisū ē et michi assueco
 omnia a principio diligēte re ordine ubi
 scilicet opte reophite: ut cognoscas
 eos uobis de q̄s erudit' eo ueritate. cā l.

Hic in diebus hōdis re-
 gis iude sacerdos quidam
 nomine zacharias de ui-
 ce abia. et uxor illi: de filia-
 bus aaron: et nomen eius: lizabeth.
 Erant autem iusti ambo a uite drum:
 incedentes in omnibus mandatis et
 iustificationibus domini sine quer-
 la. Et non erat illis filius. eo qd
 lizabeth sterilis: et ambo p uocel-
 lissent i diebus suis. Factū est autē cū sa-
 cerdotio fungeretur zacharias in ordi-
 ne uicis sue ante deū: scdm cōsuetudi-
 nem sacerdotū sicut regit ut incensum
 poneret ingressus in templū domini.
 Et omnis multitudo ppli erat orās so-
 ris hora incensi. Apparuit autem illi
 angelus dñi: stans a dextera altaris

The printing machine:
 Johann Gutenberg (Germany, 1452)