

#### A taste of Greek science Early Greek science

Homeric world-view: the nod of Zeus

Thales
solar eclipse 585 BCE, surveying, water
Anaximander (c. 560 BCE)
first map, balance of forces
Heraclitus (c. 500 BCE)

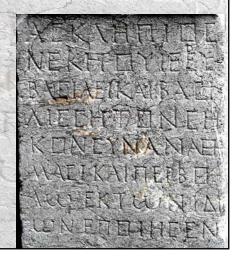
Idea of "natural law" in ethics leads to the idea that nature itself has laws.

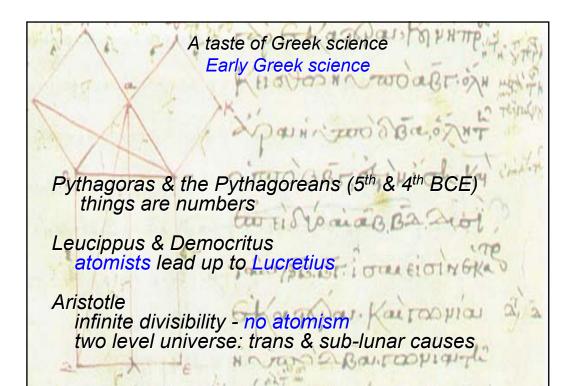
#### A taste of Greek science Early Greek science

Hippocrates of Cos (c. 460 - 370 BCE) "the father of medicine" all diseases have natural causes

Empedocles of Acragas (c. 450 BCE) 4 types of matter, 2 types of force (love, strife)

Inscription at Pergamon dedicated to Aesklepios by the "king" and "queen"





#### A taste of Greek science Early Greek science

Epicurus of Samos (c. 341 - 271 BCE) rehabilitated atomism natural laws inherent in matter (no god)

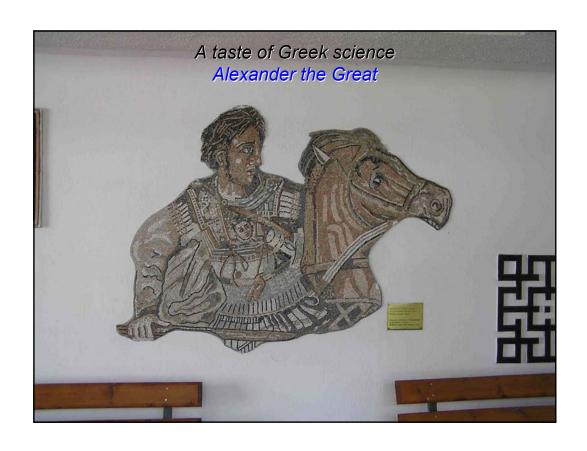


#### Stoicism

natural laws due to active pantheistic force (spermatikos logos) interacting with passive matter



Zeno of Citium







A golden age of science divorced from philosophy

Euclid's Elements (c. 300 BCE)

Archimedes of Syracuse (287 - 212 BCE)
Astronomy, Engineering, Maths

Apollonius of Perge (c. 200 BCE)

Astronomy - epicycles, Conic sections

Adelard of Bath Latin translation of Euclid's Elements, c. 1309-1316

## Hellenistic science 330 BCE to 312 CE

Earth Aristarchus of Samos (c. 275 BCE)

The earth moves in a circle about the Sun

Harris Land

Hipparchus of Nicaea (c. 190 - 120 BCE) star maps, equinox precession, brightness

Eratosthenes of Cyrene (c. 225 BCE) polymath, size of the Earth

#### Hellenistic science 330 BCE to 312 CE

Hero of Alexandria (c. 60 BCE)

Herophilus of Chalcedon (c. 270 BCE)

medicine, new drugs,

pulse, live dissection

Erasistratus of Ceos (c. 260 BCE) medicine, duodenum,

brain, live dissection

Posidonius of Apamea (c.135 - 151 BCE)
Atlantic tides, cosmic "sympathy"

Erasistratus by David 1774

#### Hellenistic science 330 BCE to 312 CE

Claudius Ptolemy of Alexandria (90 - 170 CE) Almagest, Tetrabiblos, Geography

Galen Claudius of Pergamon (129 - 200 CE)
"father of sports medicine"
the skeleton and muscles
brain signals through nerves to muscles

Galen dissected Barbary Apes & not humans, as pointed out by Vesalius.

Vesalius\_Fabrica



Syriac Christianity and the transmission of Greek science to the Arabs

A taste of Greek science

The nature and spread of Syriac Christianity
I he coming of Islam

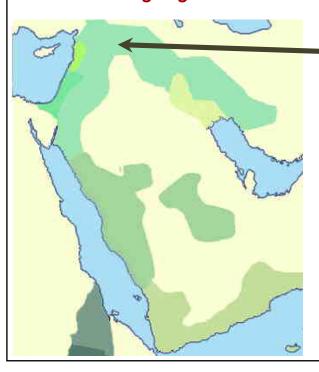
The development of science under Islam Croissants and the Renaissance

بموضعه لنبكم ودص حكمته ويونه يسوف لاكتهد

Matthew 5:8 from an East Syriac Peshitta.

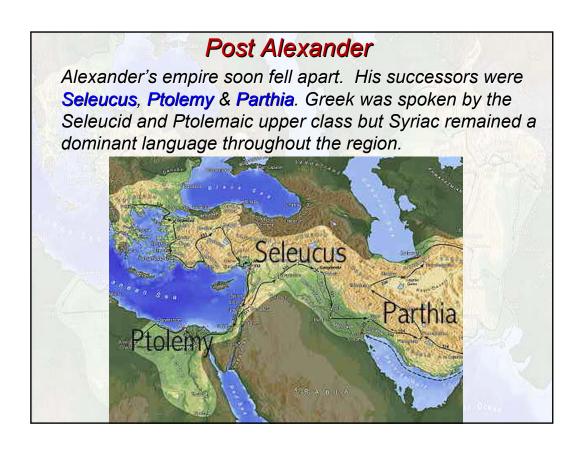
Tù bayhôn l'aylên da dkên b-lebbhôn: d-henôn ne hzôn l'alāhâ.
'Blessed are the pure in heart: for they shall see God.'

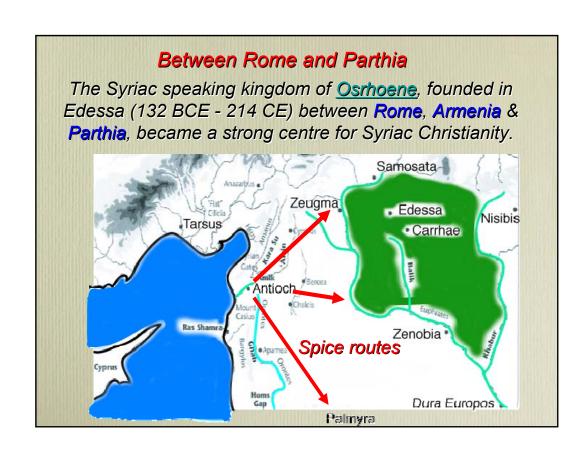
# Aramaic language distribution 1st millenium BCE

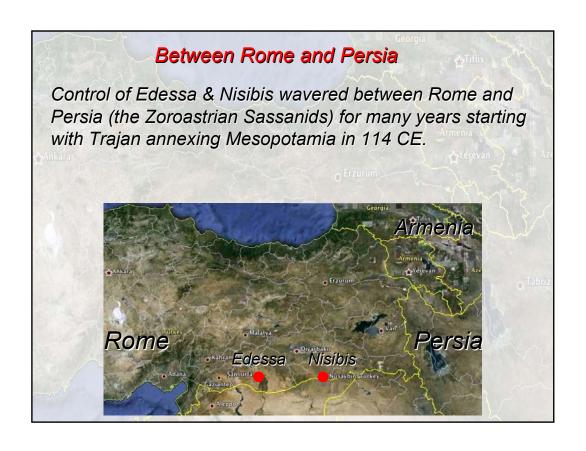


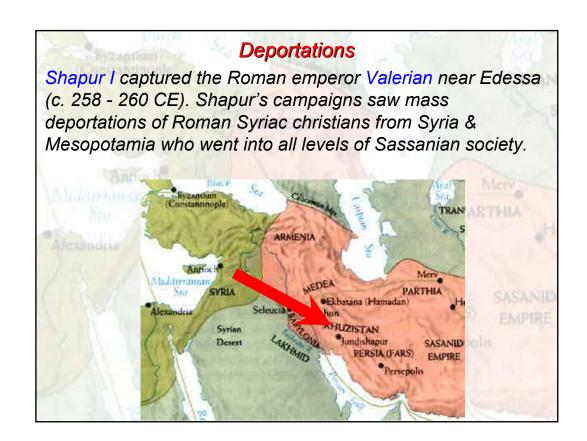
West and East
Aramaic (Syriac) in
light green

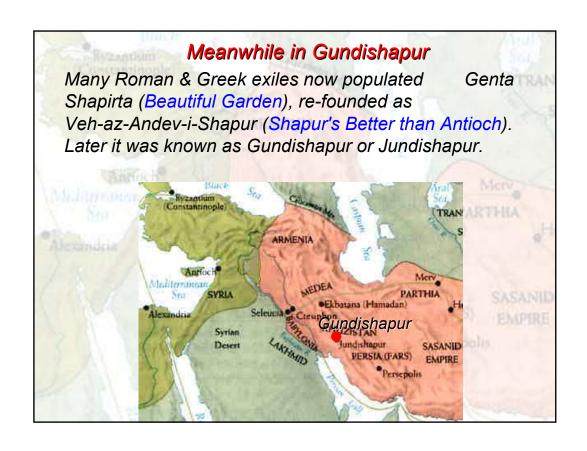
Aramaic was the lingua franca of the Middle East, used as the language of commerce from c.1000 BCE.

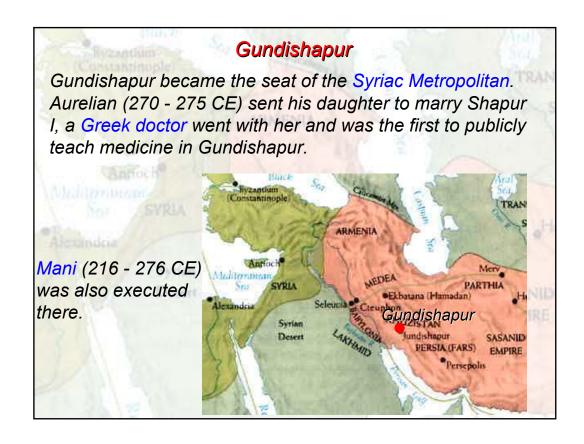












## The Academy of Nisibis

Nisibis became Roman again in 298 CE. Mar Jacob, who attended Nicaea 325 CE, founded a Syriac Christian academy at Nisibis soon after this. Ephrem became its head and most famous teacher.

It is sometimes referred to as the first University. It had 3 primary departments: Theology, Philosophy, and Medicine.

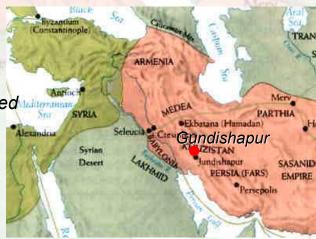


Mar Jacob Church Nisibis



About 340 CE, Shapur II founded a royal University at Gundishapur, with Syriac christians as faculty, and Syriac may have been the official language.

The lectures were probably in Syriac, though some of the teachers may have used Pahlavi, Arabic, or Greek.



#### The school of Edessa

After Julian's ill fated expedition (363 CE), the Sassanians occupied Nisibis. Ephrem who had taken a leading part in its defense fled to Roman Edessa. A school gradually developed there, with most of the Persian bishops becoming alumni. Hibha (Ibas) became its head in 412 CE.

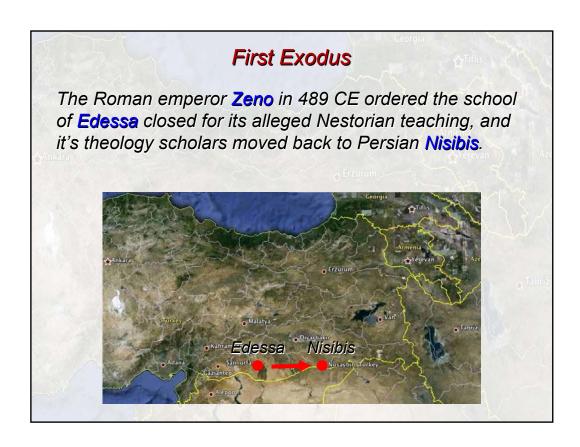


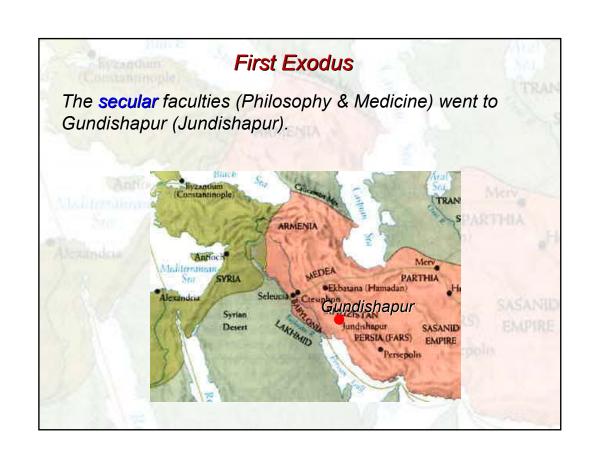
## **Ecumenical Councils**

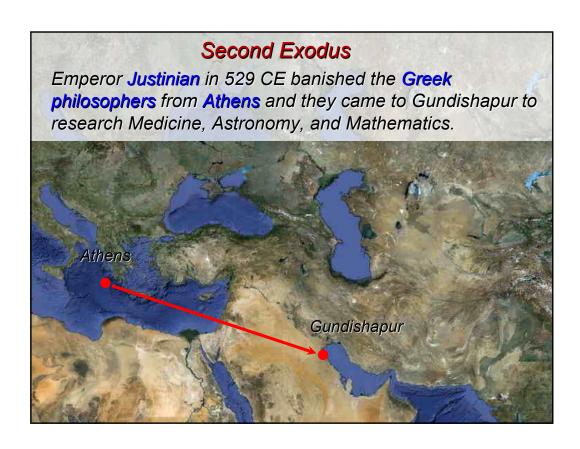
After the Ephesus council of 431 CE Syriac Nestorians became religious enemies of the Roman empire. The Chalcedon council of 451 CE did the same for Syriac Monophysites.

Syriac christians in Persia became religiously & politically divorced from Rome.









## Gundishapur

Khusrau II (531-579 CE) wanted a great academy to rival Alexandria and introduced this curriculum at Gundishapur.

He welcomed various Greek philosophers and Syriac speaking Christians fleeing religious persecution by the Roman Empire. Translations of Greek and Syriac texts were made into Pahlavi.

Note





## Gundishapur

A new system of diagnosis & treatment was developed there, considered superior to Greek and Indian medicine.

The physicians were required to pass special examinations and obtain a license in order to practice medicine.



## The Nature of Syriac Christianity

The **Teaching of Addai** (400 CE?) claims that Abgar V, King of Edessa, corresponded with Jesus and asked him to come to Edessa.

Jesus apparently declined but sent an icon with his image (mandylion).

Thomas (Jesus' twin in Acts of Judas Thomas) allegedly passed through Edessa on his way to India, where he allegedly died.

Egeria (384 CE) visited **Thomas' tomb** (allegedly then) in Edessa.

Genoa 1384 CE

## The Nature of Syriac Christianity

Christianity seems to have started among **Jews** in Edessa near the start of C 2<sup>nd</sup> CE and was widespread by the end of C 2<sup>nd</sup> CE, transcending national boundaries.

Jews had been in the region since 587 BCE and now maintained friendly relations with the Christians.

Christianity may have arrived in Edessa from the West i.e. Antioch, or it may have come from the East, i.e. Nisibis.

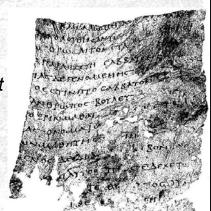


## The Nature of Syriac Christianity

Until 412 CE, Syriac Christians used Tatian's Four Gospel "mixture", both in Syriac (the **Evangelion daMehallete**) and in Greek (the **Diatessaron**).

Tatian (110 - 180 CE) was seen as a Christian, he was anti-Marcionite but ascetic.

Asceticism became a key feature of Syriac Christianity.



Non-Tatian harmony fragment from Dura Europos

## The Nature of Syriac Christianity

Bardaisan (154 – 222 CE) was the father of Syriac Christian literature and popular **hymnology**, and a **scientific humanist**.

Ephrem (306 - 373 CE) wrote popular hymns, poems and prose theology (against heresies, e.g. Bardaisan, and commentaries).

Ephrem engaged Greek science & philosophy, and Persian symbolism.

A "son of the covenant", he was celibate and later hailed as an extreme ascetic.



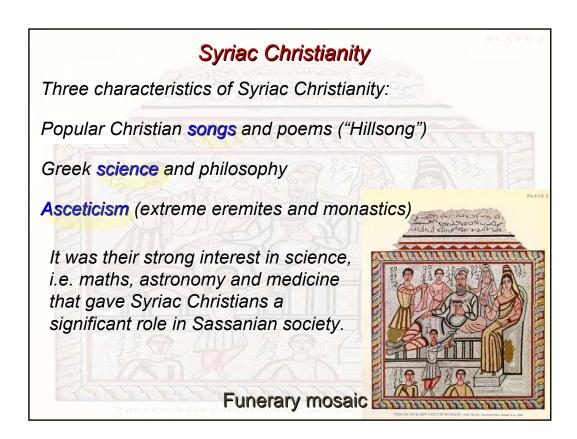
Edessa family mosaic

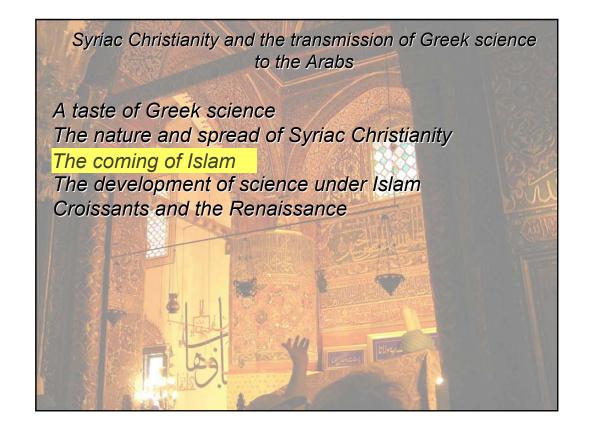
## The Nature of Syriac Christianity

Ibas (Head of the school of Edessa) used the works of Theodore of Mopsuestia (20 km E Antioch), Diodorus of Tarsus, Eusebius of Caesarea and Titus of Bostra (30 km S Antioch).

Rabbula (Bishop of Edessa) introduced the four separate gospels.

Roman theatre at Bostra





# The coming of Islam

It seems that **Muhammad** did not have any aim of foreign conquest, his goal was to **unite all Arabs**.

There is also debate whether he intended his religion to be universal or for **Arabs alone**.

Indeed there is for you in the Messenger of Alla. an excellent pattern. (Qur'an 33:21)



# The coming of Islam

Muhammad sent an envoy to **Bostra** (in Syria) to invite Arabs there to join Islam, but the envoy was killed.

In 632 CE Muhammad, in retaliation, prepared to invade Syria, but he died before the attack.

Abu Bakr sent the army which came back laden with booty.

In 634 CE a return invasion of Syria met surprising success.



## The coming of Islam

The Arabs left their conquered peoples to follow their own religion, laws, customs and use their own language.

The Arab ideal was to live at ease from the tribute of their conquests.

Taking over Damascus in 661 CE they found themselves with a highly organised Roman province and basically left it as it was for 20 years.

**Jupiter Temple at Damascus** 

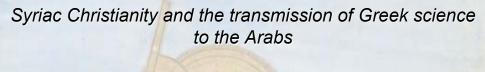


Gundishapur had surrendered to the Muslim general Abu Musa al-Ashari of (nearby) Basra in 636 CE.

The University continued to flourish under Islam, and the famous doctor **Ibn Buktishu** (Bukht Yishu' **servant of Jesus**) was head of the medical school until his death in 769 CE.

Many texts were now translated from Greek and Syriac but a significant number were translated from Pahlavi into Arabic.





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The development of science under Islam

Croissants and the Renaissance





The Development of Science under Islam

al-Mansur founded Baghdad 20/7/762 CE at a place determined by Persian and Jewish astrologers. His court physician was Jibra'il 1(son of Bukht Yishu').

Harun ar-Rashid became khalif in 768 CE.
Bringing people from Jundishapur, he made Bagdad a place for the study and advance of Greek science.

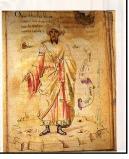
Jibra'il 2 (g'son of Bukht Yishu') was the author of **Kunnash**, a medical compendium in Syriac.



**Baghdad observatory** 

Ibrahim al-Fazari (d. 777 CE): constructed the first Muslim astrolabe c. 750 CE.

Jabir ibn Haiyan (721-815 CE): "father of chemistry", astrologer, engineer, geologist, philosopher, physicist, pharmacist and physician. Known as Geber in Latin.



### The Development of Science under Islam

Ibn Khwarizimi (780-850 CE):

"father of Algebra" from his book Kitab al-Jabr. Even From his Latinized name, Algoritmi we get algorithm.

Abu Kamil (died c. 850 CE) perfected al-Khwarizimi's work. Roots of quadratic equations. Multiplication and division of algebraic quantities.

$$(a + b)^2 = a^2 + b^2 + 2ab$$



The Development of Science under Islam

Hunayn ibn Ishaq (808-73 CE) "Sheikh of translators"

Syriac christian physician & scientist from Hira (Hirta). Translator of scientific and medical works. Mastered 4 languages: Arabic, Syriac, Greek & Pahlavi. Hunayn's method (translate the sense, not word for word) was widely followed by later translators

Al-Ma'mun (Khalif c.812 CE) placed Hunayn in charge of Bayt al Hikmah (House of Wisdom).

The eye



### The Development of Science under Islam

al-Razi (865-925 CE): physician, alchemist and philosopher. Latinised name Rhazes.

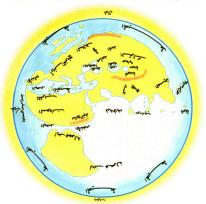
He was considered among the greatest physicians.

He wrote medical texts which were later translated. Differentiated between smallpox and measles and prescribed treatments.

Discovered al kuhul(alcohol) & naft abyad (white naphtha - kerosene).

Authored over 200 books and articles.

al-Mas'udi (c.888 - 957 CE): the "Herodotus of the Arabs" combined history and scientific geography in a 30-volume history of the world. Travelled extensively in India, the Middle East, and Africa.



### The Development of Science under Islam

Abu-Ibn-Wafa (940-997 CE) mathematician (geometry and trigonometry) made sine and tan tables.

Kitab 'Ilm al-Hisab a practical book of arithmetic, al-Kitab al-Kamil Kamil's Complete Book, Kitab al-Handsa applied geometry.

In astronomy he found 'variation' in the Moon's orbit.

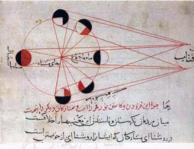
Has a crater on the Moon named after him.

al-Biruni (973 - 1048 CE) "father of geodesy".

His book Qanun-i-Masudi gives several theories of astronomy, trigonometry, solar, lunar, and planetary movements - rotation of the earth, latitudes and longitudes of various places.

al-Athar al-Baqia gives a history of nations with related geographical knowledge.

Kitab-al-Saidana is on Indian medicine.



**Lunar Eclipse** 

#### Some Arabic star names

Achernar End of the river

Aldebaran Follower of Pleiades

Altair The flying Eagle

Betelgeuse The hand of Orion

Denebola Tail of the Lion

Fomalhaut Mouth of the Fish

Hadar (Beta Centauri) Ground

Rigel Foot

Abd al-Rahman al-Sufi (Azophi)

Vega The landing Eagle/Vulture

Abu-Ali-Sina (c.980-1037 CE). Latinized as Avicenna.

He wrote about 450 books, of which around 240 have survived - 150 on philosophy & 40 on medicine.

Kitab Al-Shifa Book of Healing and

Al-Qanun fi al-Tibb Law of Medicine (a standard medical text until 1650 CE).

Latin Canon of Medicine 1484 CE

### The Development of Science under Islam

Omar Khayyam (1048 - 1131 CE)
Wrote Treatise on Demonstration of Problems of
Algebra (1070 CE) and measured the length of the year
as 365.24219858156 days.

He used geometric means to solve cubic equations.

"The Moving Finger writes, and, having writ, Moves on: nor all thy Piety nor Wit Shall lure it back to cancel half a Line, Nor all thy Tears wash out a Word of it."



#### Syriac Christianity under Islam

Syriac Christians were seen as the enemy of the Arab's enemy Rome, and so became a millet (protected minority) under Islam.

By the year 1000 CE the Syriac Christians were probably the largest church in Christendom, extending from Mesopotamia, Persia, India and through to China.

Quanzhou: Angels & Cross motif from 4<sup>th</sup> 5<sup>th</sup> C, 'cloud shoulders' in Mongol times

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Croissants and the Renaissance

How did Muslim science get back to Europe?

Siege of Vienna, September, 1683

#### Beginnings of the Renaissance

Al-Andalus (Andalusia Spain) was a mix of cultures

It had three main groups: Christians, Muslims & Jews.

Muslims were **Berbers** and **Arabs**.

Mozarabs: Christians who adopted Arabics customs, art and words, while still maintaining their Christian rituals and languages.

Alhambra

Toledo library. Gerard of Cremona translated 87 books from Arabic to Latin. Gerbert of Aurillac (later <u>Pope</u> <u>Sylvester II)</u>. Cordova medical school.

#### Beginnings of the Renaissance

Adelard of Bath (c.1080 – c.1152 CE) Known for his original works and for translating many important Arabic scientific works of astrology, astronomy, philosophy and mathematics into Latin.

He also translated some ancient Greek texts which were known in Arabic.

Euclid illumination: Woman teaching geometry



#### Beginnings of the Renaissance

Adelard of Bath (c.1080 – c.1152 CE)
Introduced Hindu-Arabic number system to Europe

"I was taught by my Arab masters to be led only by reason, whereas you were taught to follow the halter of the captured image of ancient authority"

(Tina Stiefel, The Intellectual Revolution in Twelfth Century Europe; St. Martin's Press, N.Y., 1989; pp.71, 80).

Believed the Earth round, asked how it remained stationary in space.
Theorized that matter could not be destroyed



## The Nine Crusades (1095 - 1272 CE)

The Latin Crusades brought Europe into conflict with both Islam and the Eastern Roman empire.

The 4<sup>th</sup> crusade in 1204 CE saw a horribly savage looting and pillage of Greek Constantinople.

This weakened
Constantinople and
ultimately resulted in the
victory of Islam - the
exact opposite of its
original intention.

Palma Le Jeune (1544-1620 CE)



## Tuesday 29<sup>th</sup> May 1453

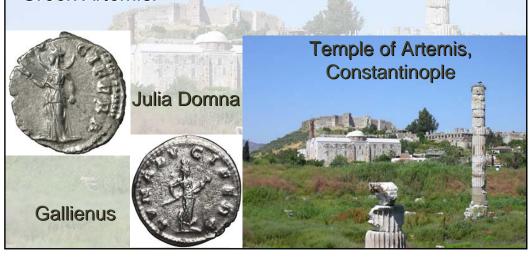
When Constantinople fell, many Greeks fled the city and migrated to other parts of Europe, Italy in particular.

This brought Aristotlean scholars back into Europe with their science and philosophy texts and may have sparked the <u>Renaissance</u>.

Constantinople painted 1499 CE

#### The crescent symbol

Before it was re-named as Constantinople, the city of Byzantium may have adopted the crescent moon as its symbol, chosen in honor of the goddess Diana i.e. Greek Artemis.



#### The crescent symbol

Various ideas:

Eastern Romans in Constantinople used the eagle. Crescent Moon & star appears on Sassanian coins. The crescent moon, by itself, may have been an early Turkic symbol from their migration from the East.



#### The crescent symbol

Croissant legends are interesting.



1217 Viennese pastry chefs allegedly prepared crescent shaped rolls for Duke Leopold for his crusade against the Moors in Egypt.

1453 Sultan Mehmed II took the crescent moon & star from Constantinople as a symbol of Islam.

1683 at Vienna crescent rolls were to be given to Turkish forces as they entered the city, hoping this might encourage leniency from Islamic overlords.

# Syriac Christianity and the transmission of Greek science to the Arabs

#### In conclusion:

The golden thread of Greek science
went East with the Syriac Christians,
who taught it to the Sassanid Persians, and
then to the Muslim Arabs, and then
went West to Europe through Spain and the fall of
Constantinople which influenced the Rennaisance.

End

## Indian influence at Gundishapur

Indian physicians came to Gundishapur.

Drugs were also sought from India, such as **sukkar** (cane sugar).

Mankah, translated Sanskrit texts into Pahlavi and conducted research on poisons.

His **Kitab al-Sumum** (The Book of Poisons) was used as a textbook at Gundishapur and he later moved to Bagdad.