People's Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research

جامعة بجاية
Tasdawit n Bgayet
Université de Béjaïa

Course : Universal history of biological sciences

CHAPTER III : MIDDLE AGES

2024/2025

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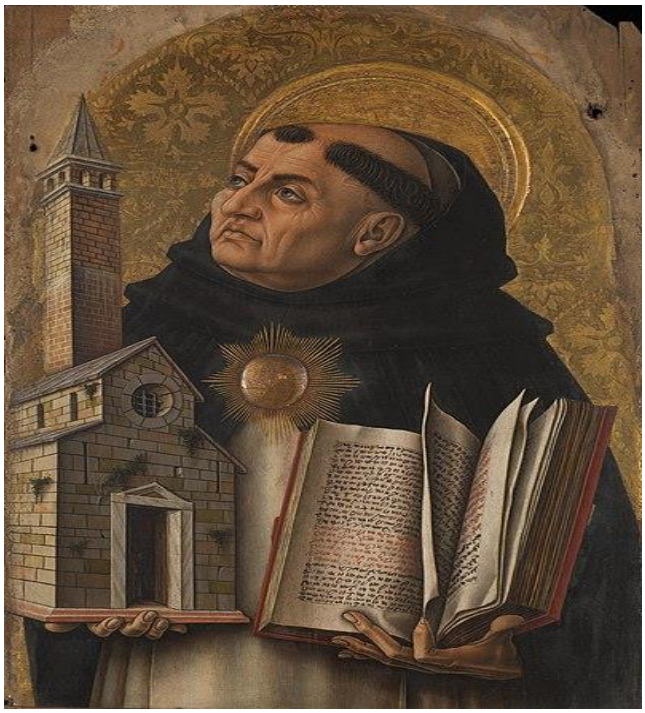
MIDDLE AGES IN THE WEST



2024 / 2025

Dr. AMIR Akila

Chapter III: Middle Ages

(476 A.D. / 1492 A.D.)

Chapter contents

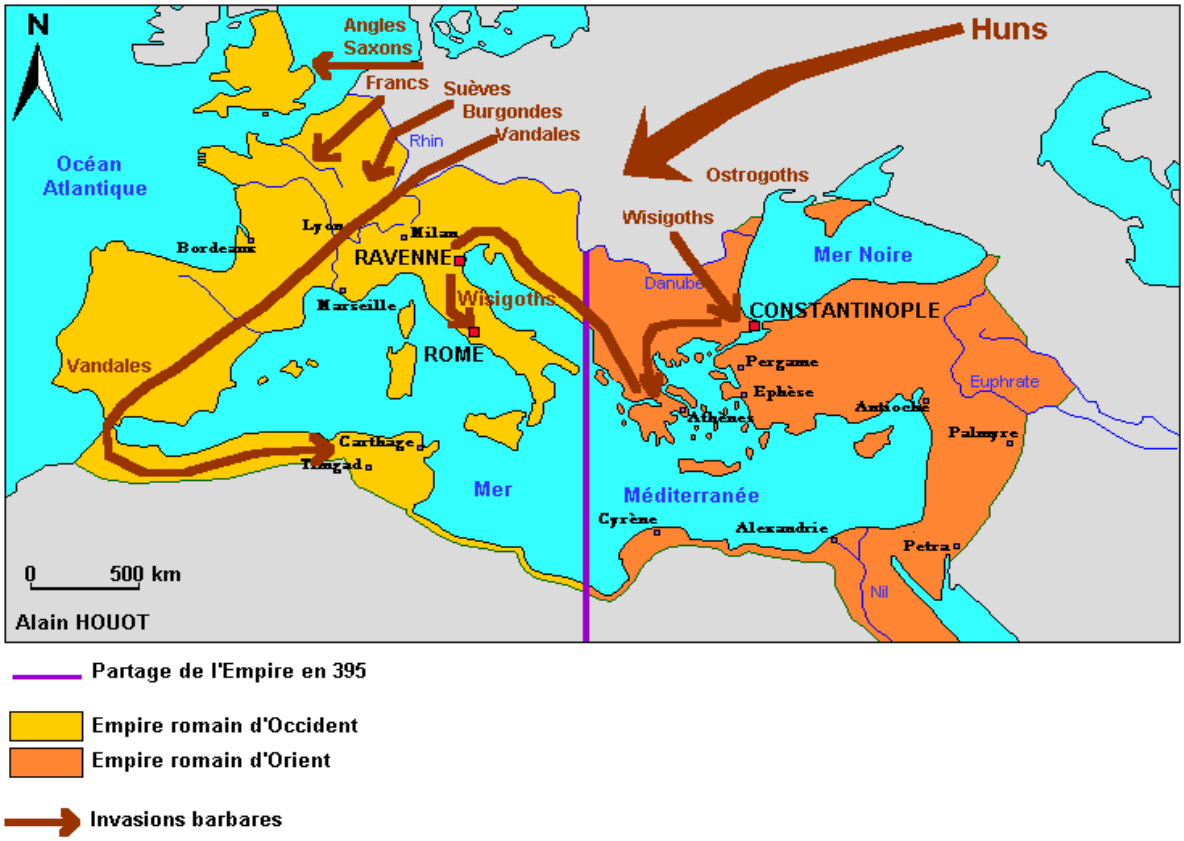
Introduction

The term “Middle Ages” is a derivative of the Latin expression “Medium Aevum”, coined in 1604 by Melchior Goldast.

The Middle Ages is the historical period that lasted almost a thousand years, between Antiquity and the Renaissance, from 476 (fall of the Western Roman Empire) to 1492 (discovery of America by Christopher Columbus).

It began with the capture of Rome by the Barbarians (all the territories of the former Western Roman Empire are now occupied by “barbarian” peoples), and ended with the capture of Constantinople, the capital of the Byzantine Empire (eastern part of the Roman Empire) (Istanbul today) by the Turks (the Ottomans).

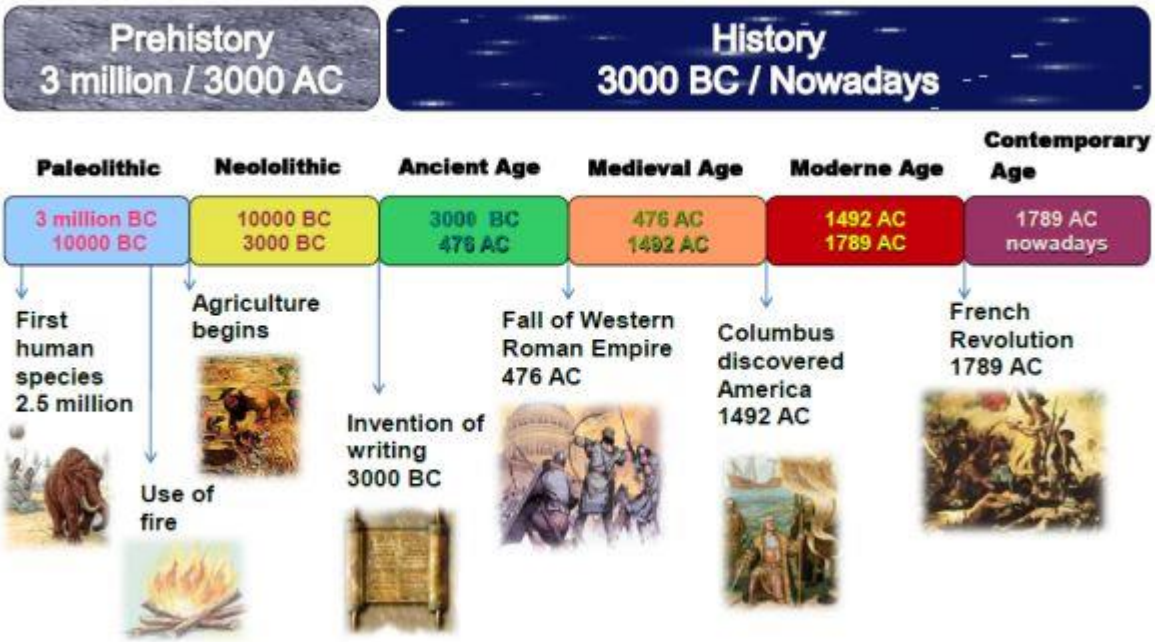
The term Middle Ages, considered pejorative, is often replaced by Medieval.



The sharing of the roman empire and the great invasions west and east

The period between the Vè and XVè centuries is considered a dark age for the life sciences. Although it was far more progressive than historians have long portrayed, the collapse of the Roman Empire and the political and economic disorders that followed it nonetheless meant that much of the legacy of antiquity was lost.

This period was called the Middle Ages, because it was considered an uninteresting transition between two golden ages: the Roman and Renaissance eras.



Chronological diagram of the four periods of history according to most French historians.

In the West, basic prejudices about the Middle Ages describe them as a period of ignorance, if not barbarism and religious fanaticism.

Historians divide the Middle Ages into three main periods:

- **The High Middle Ages (5th-10th or 11th centuries),**
- **Central or Classical Middle Ages (11th-13th centuries);**
- **The Lower Middle Ages (14th-15th centuries);**

Archaeologists, on the other hand, divide it into two periods:

- **The First (5th-11th centuries) ;**
- **The Second Middle Ages, which they extend to the 16th century.**

The (discoveries) of this period, both in the former Latin empire and in Byzantium and the Arab-Muslim sphere, can be counted on the fingers of one hand.

In contrast to this dark side, the light side is the extraordinary cultural exchange that took place, first from the Greek and Latin world to the Arab-Muslim world; then the reverse movement of translation, from Arabic to Latin. This movement led to the golden age of the Western Middle Ages, and later to the Renaissance.

The population of medieval Europe was overwhelmingly rural, living on isolated farms or grouped together in hamlets. Plots cultivated by smallholders rubbed shoulders with large estates owned by the tax authorities, the church and the aristocracy. Crops include cereals, pulses and textile plants, as well as vegetables, fruit and medicinal plants.

Islam was born in the 7th century AD. Within a century, Muslims had annexed territories stretching from Spain to China and the Philippines. Through these conquests, the Muslim empire became acquainted with Greek and Indian knowledge, and its scholars assimilated and enriched science and philosophy.

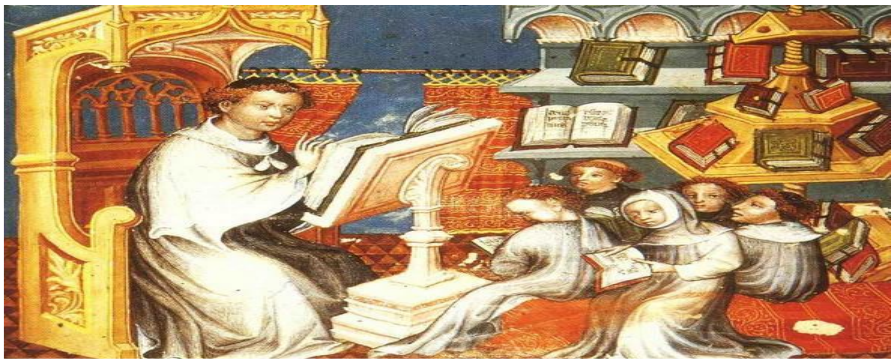
III.1 The Middle Ages in Medieval Europe

III.1.1 Main periods of the Middle Ages

A less crude view distinguishes four main periods during this period:

- **The High Middle Ages (5th - 10th century)**

In addition to the Church, economic causes and wars were responsible for the decline of the sciences during this period. The West was divided into barbarian kingdoms, of which the Franks were the most powerful. The Roman economic system collapsed. Roads, abandoned canals and aqueducts.



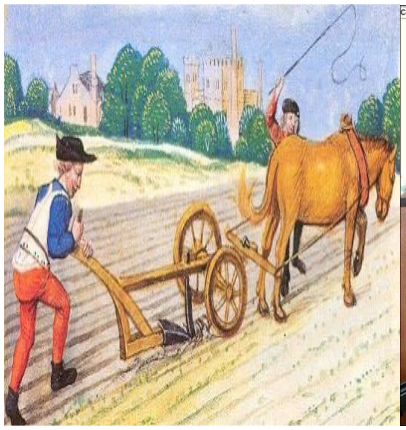
The Church, through its monasteries, preserves a small number of ancient manuscripts. The use of reason, judging that faith must prevail, contributes to devaluing technical and scientific innovations.

- **The awakening (11th-12th centuries)**

This was the time of the Crusades. These were military expeditions led in the Middle Ages by Christian armies in the name of the faith. The best-known Crusades were against the Muslims in Palestine and Spain.

The first Latin translations of Arabic works date from this period, mainly in Toledo, Spain, the main route of communication between Arab civilization and the West.

During this period, the population grew considerably, thanks in particular to a number of technical innovations: the heavy plough with a pourer, the shoulder harness for the draught horse, water mills, three-year crop rotation, etc. Bear in mind that, during this period and the next, no Western city (Paris, London or Rome) could match the splendor and wealth of Constantinople or even Cordoba or Baghdad.



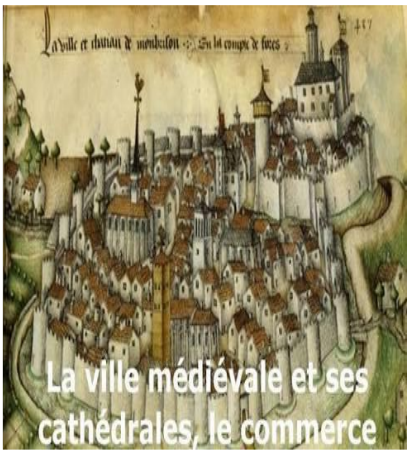
Heavy plough with pourer

Shoulder harnesses

Water mills

- **The apogee (13th century - c. 1348)**

The era of the great Gothic cathedrals. Towns grew, as did trade.



Universities developed; at first, a university was a school attached to a cathedral or monastery.

The word universitas, in medieval Latin, designates a community, a union.


Universities (Paris, Oxford, Bologna, Naples, Cambridge, etc.) developed, with scholasticism dominating. By this time, the West was taking over from the Arab world in the advancement of science.

The oldest universities in Europe are:

- **Bologna (1119)** (Italy), specialized in Law.

- **Paris (université magistorum et scolarium),** founded around 1170 and dissolved in 1793.

- **Oxford (1133),** founded by students dissatisfied with the teaching of the Paris schools.

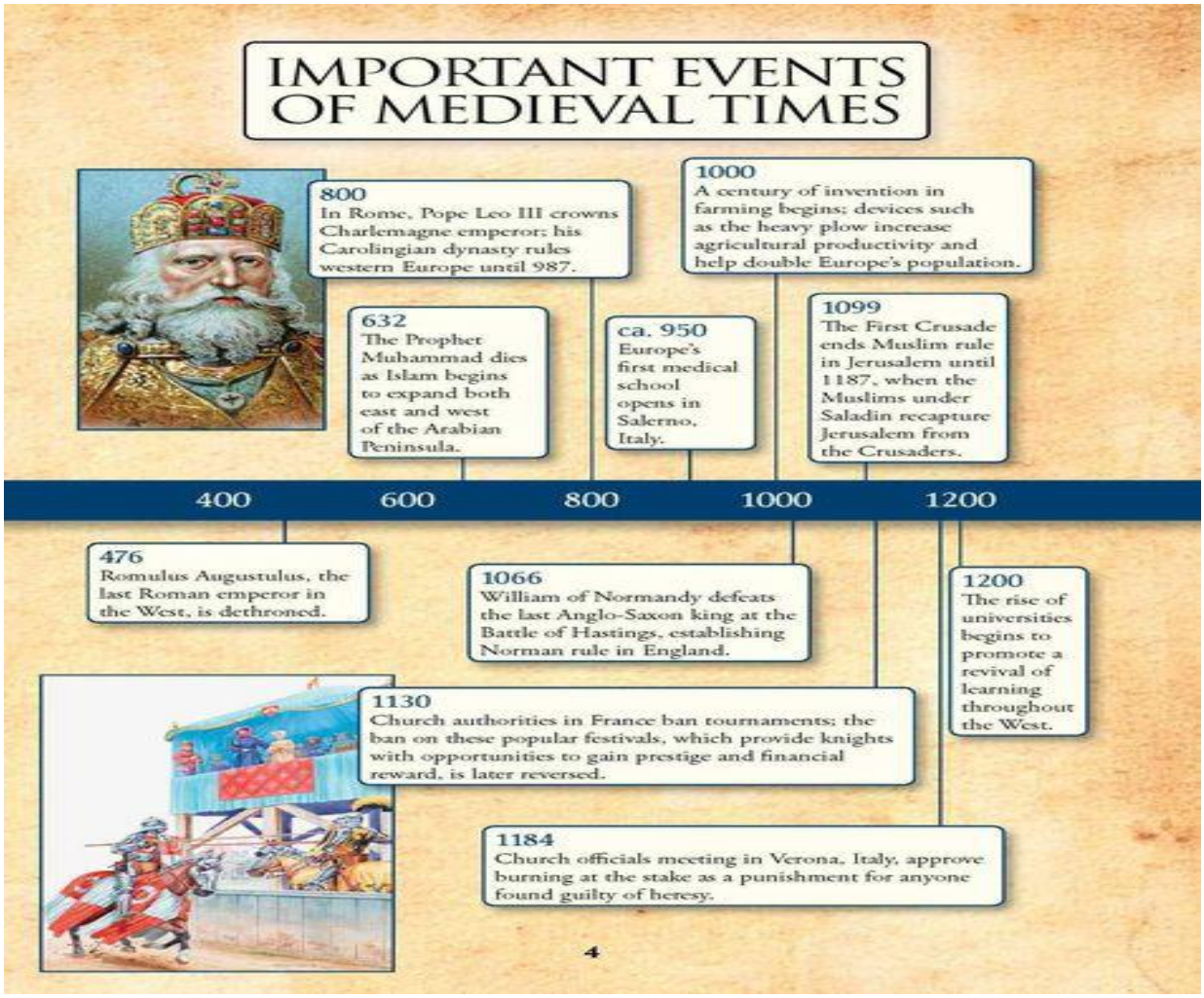
- **Cambridge (1209)**, founded by masters and students expelled from Oxford.

- **Montpellier (1289),** medical and law schools already existed in the 12th century.

- **The decline (circa 1348 - 15th century)**

The Black Death, a contagious disease originating in Asia, arrived in Europe around 1348. It is estimated that it claimed 25 million victims in Europe, or around a third of the population. It wasn't until the 16th or 17th century that the population returned to its previous level.

University teaching became fixed and rigid, but, paradoxically, techniques progressed, perhaps under the pressure of the constraints imposed by depopulation **:** progress in harnessing natural (wind and water mills) and animal motive forces; in navigation (cartography and ships); in perfecting printing, and so on. Some of these innovations seem to have come from China, then ruled by a Mongol dynasty and open to Western travelers during the Renaissance, and still bringing a wealth of knowledge in geography and cartography, disciplines in which the West had fallen far behind. Pierre d'Ailly, at the turn of the 14th and 15th centuries, wrote the Imago mundi (1410), which was used by a certain Christopher Columbus, and Fra Mauro provided the first Portuguese navigators with cartographic knowledge in the mid-15th century. They paved the way for the great discoveries made by the European navigators of the Renaissance.



III.1.1 Medieval biology in the West

There is very little to say about the biological and medical sciences in the West before the revival brought about by the translation of Arabic texts, which began in the xiè century and developed in the xiiè and xiiiè centuries.

These centuries were also a period of economic expansion : forests were cleared, and trade and towns developed.

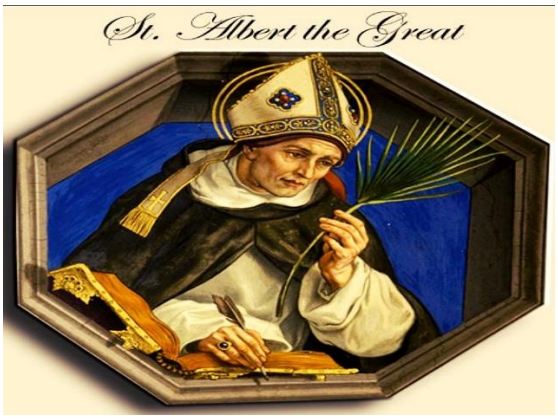
The first universities were built near cathedrals, in Bologna at the end of the xiè century, and in Paris and Oxford in the middle of the following century. Medical schools were also founded, in Salerno in southern Italy, and later, at the end of the XIII century, in Montpelier.

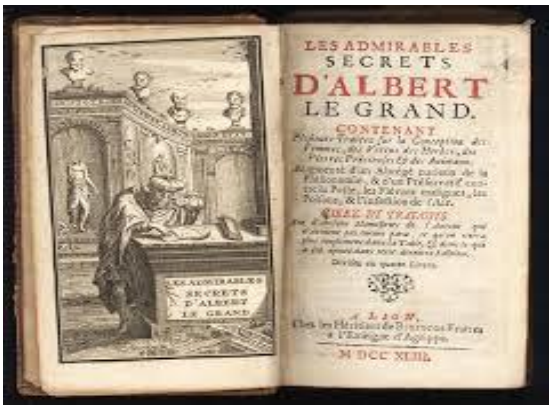
Aristotle's recently rediscovered writings are being discussed, and we're even seeing the emergence (or re-emergence) of experimental approaches in the field of physics. However, it's hard to discern any real novelties or to describe discoveries in the biological and medical fields.

The rare authors who have contributed to biology are those who escaped scholasticism and, in particular, the dictatorship of Aristotle :

- **Albert the Great (Albertus Magnus)**

Born in Germany, Albert the Great wrote a treatise on animals, De Animalibus, in 26 books, 21 of which are devoted to the comparative anatomy of man and animals. His ideas on embryology were inspired by Aristotle, and his philosophy by Hippocrates. For him, the heart is the seat of vital heat.





- **Frederick II of Hohenstaufen**

King of Sicily, then Emperor of Germany, was the author of a remarkable treatise on falconry, the "Encyclopédie Ornithologique sur la morphologie, la physiologie, ect de divers oiseaux". Passionate about scientific research, in 1241 he promulgated a law authorizing the dissection of human cadavers, which was unfortunately revoked by the church after his death.

MIDDLE AGES IN THE EAST: ARAB-MUSLIM CIVILIZATION

(800 1200)

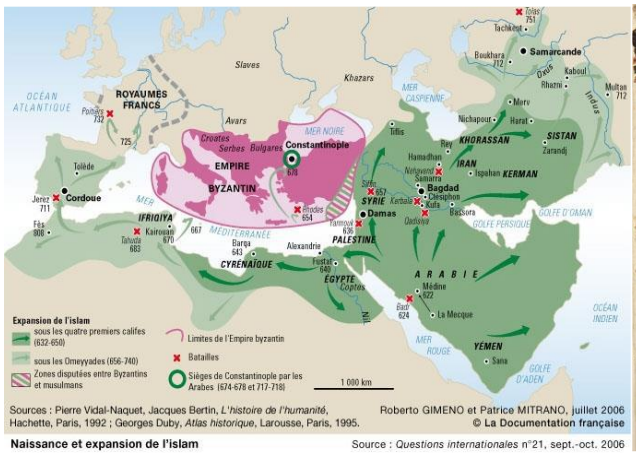
2024 / 2025

Dr. AMIR Akila

III.2 Arab-Muslim civilization (In the East)

The beginning of Arab-Muslim civilization was marked by the arrival of Islam in the early 7th century in Arabia, until then a country of secondary importance.

Arabia was a vast desert peninsula (Arabia = arid), which imposed severe constraints on the population. In the 6th century, the 5/6 were nomads, shepherds moving from one meagre pasture to another. Within a century of the arrival of Islam, the Arabs had conquered the whole of the Near East, North Africa and Spain, at an unprecedented pace. They took over half of the Eastern Roman Empire (Byzantine Empire) and all of Sassanid Persia, highly civilized lands. In fact, the Arabs assimilated the knowledge and sciences of the conquered peoples.



III. 2. 1 Character of Arab science

Arab science is not just the science of the Arab peoples, but science in Arabic, which includes many Persian and even non-Muslim (Jewish) scholars. In fact, during the first century of ISLAM, the majority of scholars in Muslim territory were Christians. To a certain extent, the Islamic religion was more favorable to the development of scientific knowledge than the Christian religion at the same time. Not only is astronomical knowledge important for determining the precise start of Ramadan and the direction of Mecca, but the Koran also encourages the study of Nature: " Whoever walks in search of science ['ilm], God walks with him on the path to Paradise".

The special place held by العلم (l'ilm) knowledge, or science, in Islamic tradition has its roots in the Koran. As a result, the quest for knowledge is equated with a religious duty.

Muslim leaders have encouraged scientific research and the dissemination of knowledge.

Exp: Harun ar Rachid (caliph from 786 to 809) imposed the use of paper in all the empire's administrations.

Schools and libraries were built Al Mamun (caliph from 813 to 833) brought together scholars from all backgrounds and religions in Baghdad. In 829, he created the world's first permanent observatory in Baghdad, the Baghdad Observatory, which enabled astronomers who had translated the Greek Hipparchus' Treatise on Astronomy, along with his catalog of stars, to study the movement of the stars. In 832, the House of Wisdom (Baït al hikma) was founded, an institution designed to develop teaching and research. The translation of Greek works was one of the main activities of the House of Wisdom.

Contact with the Chinese led to the acquisition of certain Chinese techniques, such as papermaking. Paper soon replaced parchment in the Muslim world, with factories being set up in Samarkand, Baghdad, Damascus and Cairo.

III.2.1.1. Main cultural and scientific centers in the Muslim world

- In the Middle Ages, Andalusia, Saragossa, Toledo and Cordoba were Spanish cities. (Averroes Ibn Rochd de Cordoue was born in Cordoba).

Cordoba

Toledo

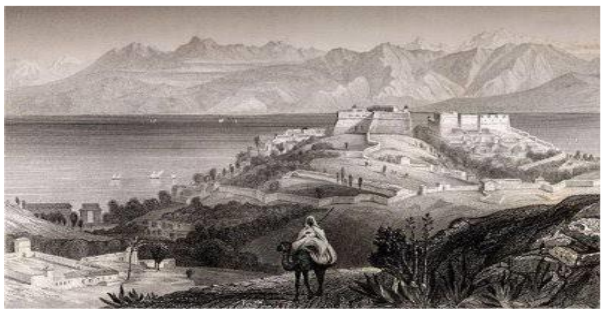
Zaragoza

- **Fez and Marrakech (Morocco)**

Fez

Marrakech

- **Bejaia (Algeria)**



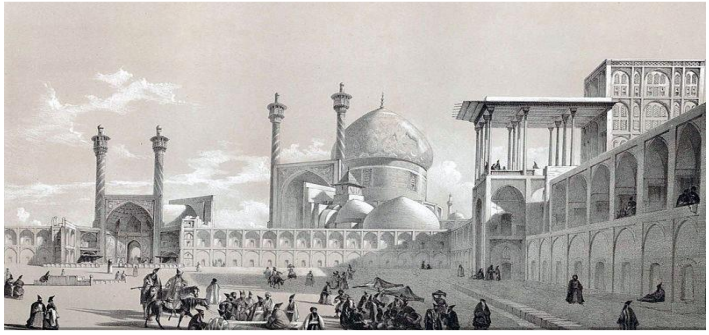
- **Kairouan (Tunisia)**

- **Cairo (Egypt)**

- **Damascus (Syria) capital of the Umayyad dynasty**

- **Baghdad (Iraq): capital of the Abbasid dynasty**

- **Maragha, Rayy, Shiraz et Ispahan (Iran)**



- **Samarkand (Uzbekistan): famous for its birdwatching**

III.2.1.2. Translation into Arabic of scientific works in various languages

During the Renaissance, a return to learning Latin and Greek was essential for Arab scholars of translation. This is how couriers of knowledge were mobilized to translate medical, philosophical and astronomical texts, ... The Arabic language was soon enriched by these translations.

III. 2.1.3. Assimilation of new knowledge

In contrast to the Church, Islam encourages the search for knowledge in all its forms. Translation can be seen as a scientific methodology, enabling the dissemination and diffusion of ancient knowledge not only within Arab and Muslim societies and in the regional sphere, but above all throughout the world.

a) Mathematics

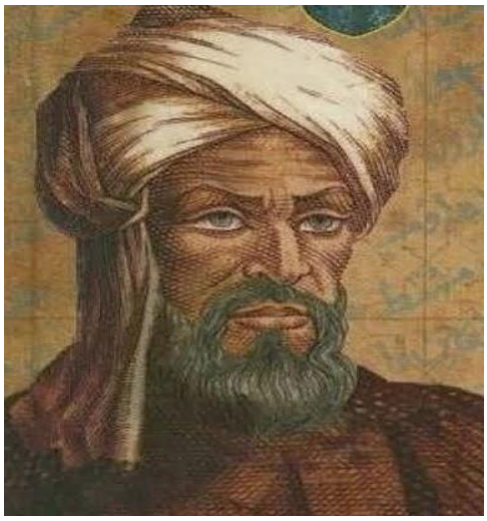
The Arab-Muslim civilization played a major role in the history of mathematics, not only preserving but also deepening the ancient heritage. This role was particularly innovative in algebra, with the adoption at the end of the 8th century of the decimal system and Arab-Indian numerals (unlike Roman numerals, with the zero).

- ***Al Khawarizmi*** was a Persian mathematician, geographer, astrologer and astronomer, member of the Baghdad House of Wisdom. Founder of algebra.

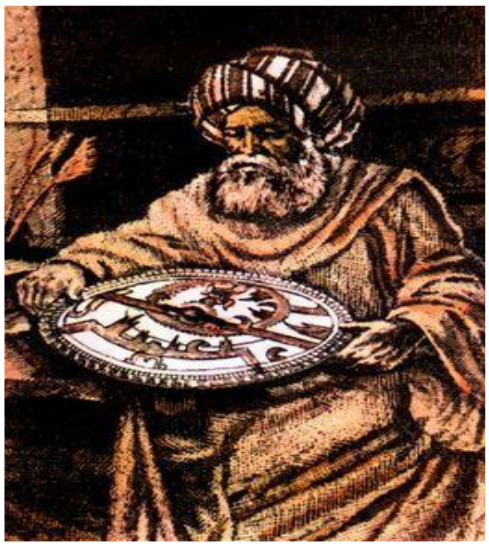
Al Khawarizmi 800 / 847 author of the Précis sur le calcul de al-jabr et de al-muqabala (Algebra).

He introduced Indian decimal numbering into Islam. The word al-jabr became “algebra” in Latin and “Algèbre” in French.

The Latinized name of al Khawarizmi is algorismus, the origin of the French word algorithme.



- ***Al battani Albategnius*** (9th century), astronomer and mathematician who introduced sines and cosines into Arab mathematics.



Mathematics was used by Arab scholars as an adjunct to other disciplines, such as astronomy and geometric construction techniques (mosaics, domes).

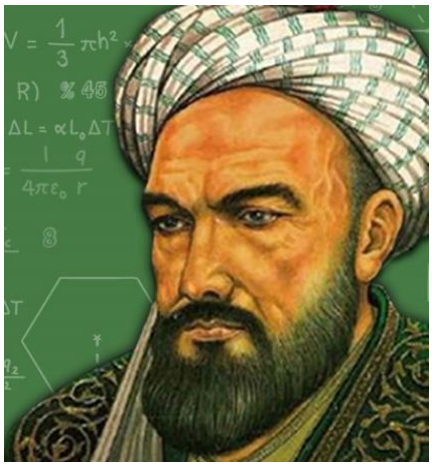
But also for purely religious purposes, to calculate geographic coordinates and indicate the direction of Mecca.


- ***Ibn al haytham: (965/1040)*** the Arab world's most famous physicist (Prince of Light). He studied the process of vision and criticized Ptolemy's suggestions that vision was based on radiation emitted by the eye. He studied the phenomena of light refraction and reflection in detail, and defined the basic principles of eye autopsy. He specified the parts and function of each part of the eye, as well as the mechanisms and psychological factors or external influences on the vision process. His book Optics".

b) Geometry

In geometry, Islamic mathematicians took up the Greek work of Euclid. In this way, Arab Muslims were able to appropriate the achievements of Antiquity and use them as a basis for their own development.

- ***Nasir ad-Din at-Tusi (1201, Tus, Iran - 1274),*** Persian mathematician from Khorassan. (800 Al-Khwarizmi. He is credited with introducing trigonometric functions.



c) Medicine

Medicine inspired by the Koran and hadiths.

The Muslim empire dominated medicine in the Middle Ages, due to personalities such as :

- ***Avicenna (or Iben Sina)***: Real name **Abu Ali al-Husayn ibn Abd-Allah Ibn Sina**, Avicenna was a physician and philosopher born in 980 and died in 1037. His career and writings were part of the cultural golden age of Islam. His biography is known thanks to the account left by his secretary, disciple and friend al-Djourdjani.

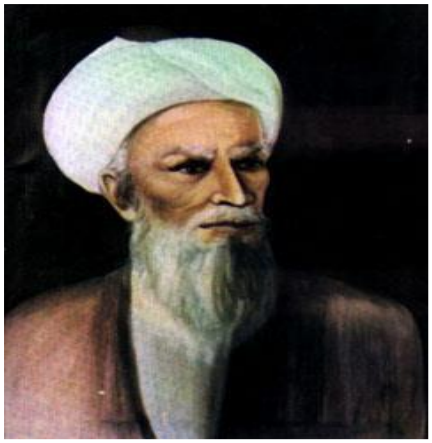
Even before being a politician, Ibn Sina was a remarkably gifted physician. He translated some of the works of Galen and Hippocrates himself, and practiced dissection to "**penetrate the secrets of the human body**". His contribution to medicine was based above all on his own observations and direct experience, but also on a rigorous use of logic (he posited premises from which he then deduced logical consequences).

His major work remains **the Canon of Medicine (Kitâb al-Qanûn fi Al-Tibb,** literally **the Book of Medical Laws**). This book, brought back to the West and translated into Latin between 1150 and 1171 by Gerard of Cremona, was to have a key influence in the West, replacing Galen, until it was challenged by Renaissance scholars.

- ***Abu Bakr Mohammad Ibn Zakariya al-Razi,925-865) ((رازی)*** was an Iranian multidisciplinary scholar who made important contributions to medicine, alchemy and

philosophy. An alchemist turned physician, he is said to have isolated sulphuric acid and ethanol, whose medical use he was among the first to advocate (initiating the use of alcohol and surgical thread in medicine, and founding the first hospital).

In terms of medical practice, he vigorously defended the scientific approach to diagnosis and therapy, and greatly influenced the conception of hospital organization in conjunction with the training of future doctors. Hospitals served both as medical schools and as places of care, which corresponds to the invention of hospital medicine. Empiricist and rationalist, he was widely criticized for his opposition to Aristotelianism and his free-thinking towards the Muslim religion.



- ***Ibn Nafis (Ala-al-din abu Al-Hassan Ali ibn Abi-Hazm al-Qarshi al-Dimashqi)***

(علاء الدين أبو الحسن عليّ بن أبي حزم القرشي الدمشقي)

Better known **as Ibn Nafis**ابن النفيس) born near Damascus around 1210 and died in Cairo in 1288, was an Arab physician and philosopher who practiced and taught in the hospitals of Damascus and Cairo in the 13th century.

He is credited with being the first to accurately describe **the small blood circulation** or **pulmonary circulation**, in Cairo in 1242.

The most voluminous of his books is **Al-Shamil fi al-Tibb** (Commentaries on the Anatomy of Ibn Sina's Canon of Medicine), an encyclopedia planned for 300 volumes, but unfinished due to his death. The manuscript is available in Damascus.

➢ ***Averroès (Abū l-Walīd Muḥammad ibn Aḥmad ibn Muḥammad ibn Rušd***) (whose name became, for the West, Averroès, when his works were translated into Latin)**.** He was an Arab-speaking Andalusian Muslim philosopher, theologian, jurist and physician of the 12th century, born in 1126 in Cordoba, Andalusia, and died on December 10, 1198 in Marrakech (present-day Morocco).

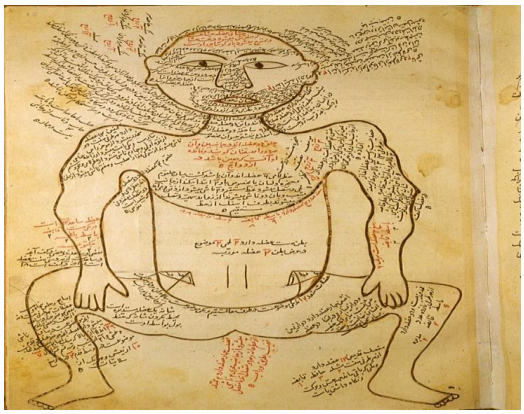
He served as grand cadi (supreme judge) in Seville and Cordoba, and as private physician to the Almohad sultans. A critical reader of Al-Fârâbî, Al-Ghazâlî and Avicenne, he is considered one of the greatest philosophers of Islamic civilization.

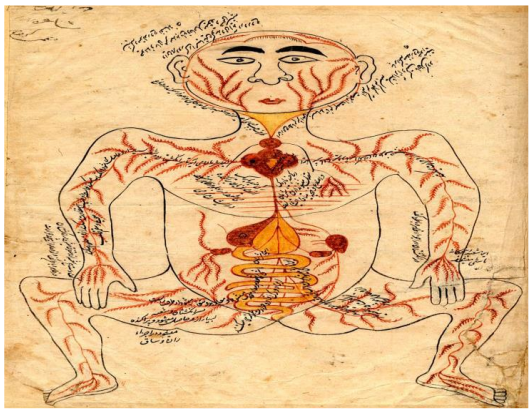
His works include

- ***Colliget (1161, second version in 1194),*** corruption of the Arabic word al-Kulliyât الكليات)) meaning the Book of All or Generalities [on medicine], published in Venice in 1482.
- ***Comments on Avicenna's canons, published in Venice in 1484.***
- ***Exposé du poème médical d'Avicenne, Venice 1552.***
- ***Average comments on Galen.***
- ***Traité de la thériaque, Venice 1562.***

➢ ***Abu el Qasim al zahrawi*** : In the 11th century, the Andalusian أبوالقسيم الزهراوي (Abu el Qasim al zahrawi) (known as Abulcassis in the West) wrote a seminal work on surgery.

➢ ***Mansour ibn Ilyas 1390*** Author of the Tashrih al Badan Anatomy of the body, which contains detailed plates depicting body structure, the nervous system and blood circulation.





Anesthesia, practiced in Antiquity by the ingestion of opium, mandrake or various other substances, was perfected by the use of a sponge soaked in a mixture of these substances, which plunged patients into a state close to general anesthesia (loss of consciousness, enabling the surgeon to operate more easily).

The Arabs translated the treatises of Dioscorides (De Materia Medica), the Greek father of pharmacology, and advanced pharmacopoeia (books of plants for therapeutic use).

Manuscrit arabe du XIVe siècle

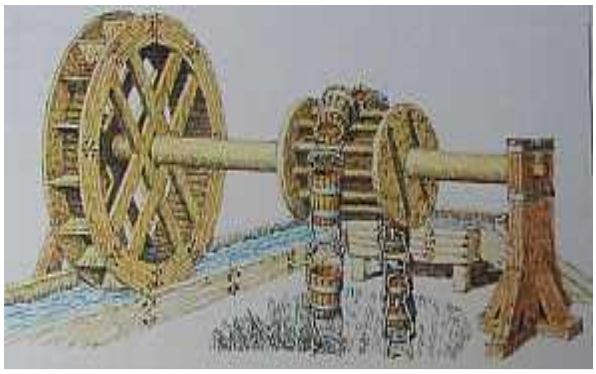
The word syrup comes from the Arabic word Charab. The use of alembics (al inbïq) (distillation apparatus), enables substances such as rose essence to be distilled.

c) Technology

- ***Al Djazari الجزري*** : Many hydraulic machines were described in his treatise "Recueil utile sur la théorie et la pratique de l'art des procédés ingénieux". One of history's greatest engineers and inventors.

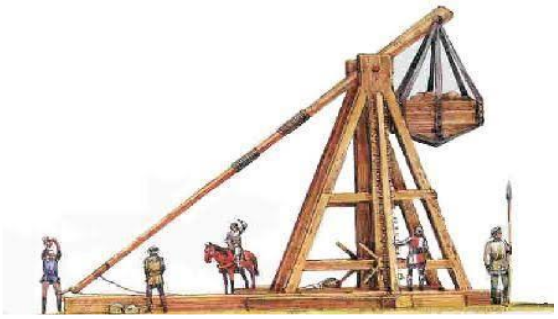
They took an interest in the problems of irrigation and developed many types of mills that were already known to the Romans, as irrigation was already an ancient necessity in semi-arid regions.

The noria is a hydraulic machine that raises water by using the energy produced by the current to irrigate crops.



In the military field, they developed techniques discovered in China and perfected new devices that made them forerunners in the use of gunpowder.

Harquebuse



Trébuchet

e) Astronomy

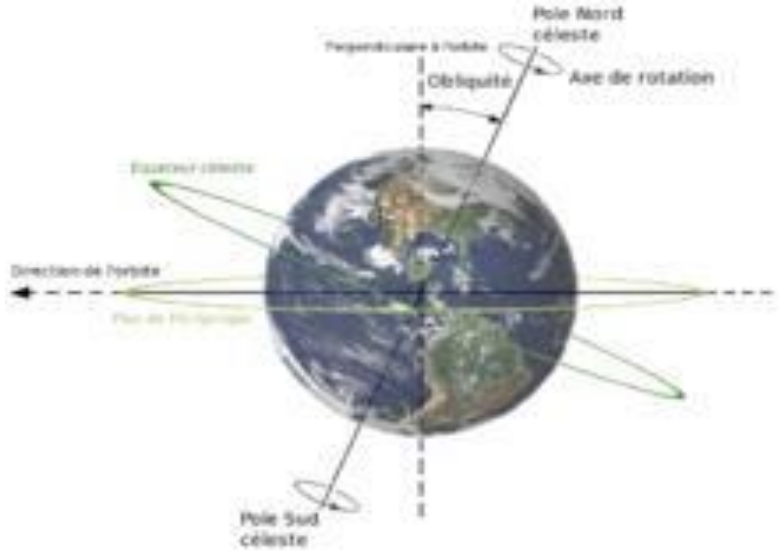
Arab astronomy was concerned with solving problems related to the practice of Islam

- Determining the dates of Ramadan,
- Calculating the time of the five daily prayers,
- determining the direction of Mecca

We mustn't lose sight of the fact that Muslim civilization is based on a lunar calendar (also known as the Hegirian calendar) based on a 12-month year of 29 to 30 days each.

The Arab astronomer ***al Farghani*** wrote extensively on the movement of celestial bodies.

At the end of the 10th century, a large observatory was built near Tehran by the astronomer **al Khujandi.** He made a series of observations that enabled him to calculate **the obliquity of the ecliptic.**



There are many Muslim scholars dealing with astronomy (al Battani, alFarabi, Omar Khayyam, al Kindi, al Hasib, al Misri, al Maghribi, al Razi, Ibn al Haytham, al Biruni, al Sufi, **al Tusi**, al Kashi, Taqi al Din);

Planetary motion according to Al Tusi. 22

Abu Raihan al Biruni 973 1048 calculated the Earth's diameter, and asserted that the Earth would rotate on itself, long before Galileo 1564 1642, taking up the writings of Eratosthenes of Alexandria dating from the 3rd century BC.

During the Middle Ages, Arab geographers such as Idrisi, Ibn Battuta and Ibn Khaldun preserved and enriched the Greco-Roman heritage. The first Muslim geographers perpetuated the work of ancient geographers (Herodotus, Pliny the Elder, Ptolemy).

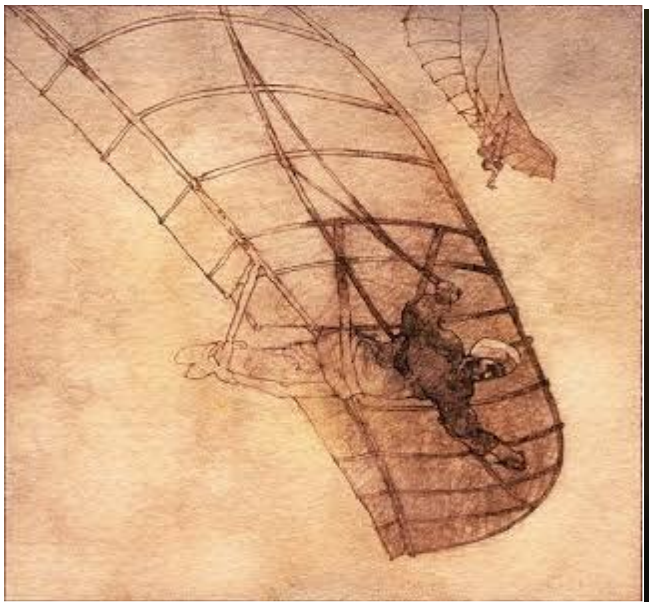
Cartography progressed during the golden age of Muslim civilization. The compass, handed down from the Chinese, made it easier for merchants to move around.

f) Key personalities of Arab science

- ***Jabir Ibn Hayyan*** (8th century) was a leading figure in Arab and Western alchemy, the "father of chemistry". He exerted an enormous influence on chemistry until the 18th century. He introduced the experimental method to chemistry.

- ***Ibn firnas (810 / 887)***

Who in 880 built the first flying machine made of fabric and feathers.




- ***Al Biruni (late 10th century)***

Astronomer, geographer, mathematician Author of 13,000 pages of technical tests.

- ***Ibn al haytham alhazn (965 / 1040)***

The Arab world's most famous physicist (Prince of Light). He studied the process of vision.

He studied the phenomena of refraction and reflection of light in detail and defined the basic principles of eye autopsy.

g) Decline of scientific activity

The decline of Arab science is a long and uneven process. The extent of the empire gave rise to contrasting situations. There were many reasons for the slowdown in activity. As early as the 13th century, successive waves of Mongol invasions had disastrous consequences for the scientific movement of the Islamic Middle Ages.

The development of printing in 1438 widened this gap even further.

In the East, political power forbade any printing of texts in Arabic or Turkish, whereas in the West, printing played an essential role in the dissemination and development of scientific knowledge.