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General Introduction

The Middle Ages, spanning from the 5th to the 15th century, occupies a pivotal position in European history, signifying the transition from the decline of the Western Roman Empire to the advent of the Renaissance and the Great Discoveries. Positioned between Antiquity and modern times, this era is meticulously divided into the High Middle Ages (6th - 10th century), central Middle Ages (11th - 13th century), and late Middle Ages (14th – 15th century).

Commencing in 476 with the deposition of the last Western Roman emperor, the Middle Ages' conclusion is conventionally marked at the end of the 15th century, yet contextual variations exist, such as the fall of Constantinople in 1453, Christopher Columbus's inaugural voyage in 1492, or the start of the Protestant Reformation in 1517. Despite these symbolic dates, contemporary historiography posits the Renaissance, spanning from the 15th to the mid-16th century, as the true bridge from the Middle Ages to modern times.

The Western Middle Ages, extending from 476 to 1492, covers a span of one thousand and sixteen years, with the Renaissance acting as a transitional phase. Despite being often labeled as the Dark Age, this period witnessed the preservation and enrichment of Greek sciences through Arabic translations, particularly during the Arab-Muslim civilization's golden age.

The Middle Ages, marked by theological dominance and a relative stagnation of sciences, saw rare individuals making strides in biology, including figures like Averroes, Michael Scot, and Abu Muhammad Ibn al-Baitar. The Renaissance, occurring at the Middle Ages' closure, ushered in transformative innovations in navigation, cartography, and medicine, fostering a renewed interest in various scientific disciplines.

Advancements in the Renaissance, ranging from the invention of the printing press to astronomical discoveries and the evolution from alchemy to modern chemistry, signify a profound shift in the scientific landscape. The dissemination of knowledge improved, allowing for mass education and the formation of a scientific community, creating a bridge between distinct disciplines united by scientificity and mathematics.

As the Renaissance unfolded from 1450 to 1600, it marked a period of rebirth and transition, witnessing the popularization of innovations like the compass and sextant, developments in cartography, and the emergence of figures such as Christopher Columbus, Leonardo da Vinci, and Galileo. This era not only reshaped Europe's geographical and cultural identity but also laid the foundation for the autonomy of science and the development of its first theoretical systems. In this chapter, we will provide full detail on what was mentioned in the introduction, and our focus will be on the Middle Ages and the Renaissance eras.

III. THE MIDDLE AGES: (Western, and Eastern)

The **Middle Ages** is a period in the history of Europe, extending from the 5th century to the 15th century, which began with the decline of **the Western Roman Empire** and ended with **the Renaissance** and the Great Discoveries. Located between **Antiquity** and **modern times,** the period is subdivided between: **the High Middle Ages** (6th - 10th century), **the central Middle Ages** (11th - 13th century) and **the late Middle Ages** (14th – 15th century).

The most commonly accepted date for the starting point of the Middle Ages is **the year 476,** when the last Western Roman emperor was deposed, and this was first proposed by **Bruni.** The end of the Middle Ages is generallyplaced at the end of the 15th century but depending on the context, the exact date may vary. We can for example cite the fall of Constantinople in 1453, the first voyage of **Christopher Columbus** in 1492 or the start of the Protestant Reformation in 1517. These symbolic dates alone do not mark a change of era and contemporary historiography considers that the Renaissance period from the beginning of the 15th century to the middle of the 16th century marks the transition from the Middle Ages to modern times. In the same way, there was no sudden passage from Antiquity to the Middle Ages but a fairly long process called Late Antiquity extending from the end of the 3rd century to themiddle of the 7th century. A broader definition is given by **Jacques Le Goff,** defender of a Western ***"long* Middle Ages"** which would extend from the 4th century (the establishment of Christianity) to the 18th century (the industrialrevolution in Great Britain and the French Revolution), contesting the idea that the Renaissance would have put an end to medieval culture.

The Western Middle Ages is therefore located between 476 and 1492 years after Jesus Christ. It extends over aperiod of one thousand and sixteen years. The Renaissance is a period of transition between the Middle Ages (≈476-1492) and modern times (≈1492-1789).

In the Middle Ages , the Greek sciences were preserved, in particular by the translation into Arabic of many books, present in the Library of Alexandria. These sciences are then enriched and disseminated by **the Arab-Muslim civilization** which then lives a golden age (Al-Khwarizmi, Avicenna, Averroes). We owe him many works in astronomy,geography, optics, medicine, but also in mathematics (mainly algebra, combinatorial analysis and trigonometry).

The Eastern Middle Ages go back to Antiquity when the first civilization would have settled in Sumer in Mesopotamia. The establishment of the Sumerians dates back to the Uruk period, that is to the 4th millennium BC .For several millennia, the Middle East was one of the

centers of cultural and scientific development among the mostimportant in the world, contact with European, African and Asian civilizations led to the development of the exchange of goods, knowledge and multiple conflicts for the control of wealth, holy places, or communication channels. So, theIslamic civilization greatly improves knowledge and culture, for example the schools of medicine. The Arabs will import paper into the West, buying the technique from the Chinese and then importing it into Europe through their conquests.

The Middle Ages (The Dark-Age) is the time of the reign of theology (the inquisition), a very long period in whichthe sciences are blocked, in regression and have even become prohibited. Only a few rare people will be able to afford to do a little biology, and still very badly:

- **Averroes (1126** to 1198) is a cultured Spaniard who translates ancient texts into Arabic, and translations of thescholastic philosopher.
- **Michael Scot** (1175-1236), this will be the starting point of a renewed interest in the animal world.
- **Abu Muhammad Ibn al-Baitar** (1190-1248): is an Arab physician and botanist who devoted several works to the pharmaceutical knowledge of his time. In particular, he described the properties of more than 1400 species ofplants.
- **Vincent de Beauvais** (1190-1267) is the author of the *Speculum Naturale* or *Mirror of nature* in which hesummarizes the knowledge of his contemporaries in natural history.

- **Frederick II of the Holy Empire** (1194-1250) wrote an illustrated manual of falconry and ornithology, “De Arte venandi cum avibus”, in which he described more than 900 species of birds. He records very precise observations on the behavior of birds, farahead of his time. He does not hesitate to criticize Aristotle, whom he criticizes for having only a theoretical knowledge of birds.
- **Albert the Great** (1200-1280) is the author of a vast treatise, De *animalibus,* devoted not only to fauna, but also to flora andminerals. authored 21 books on anatomy.
- **Thomas de Cantimpre** (1201-1272), whose *De Naturis Rerum* is a compilation of knowledge of the time in natural history.
- **Konrad von Megenberg** (1309-1374), whose best-known work, “ *Das Buch der Natur”* was the first text on natural history writtenin the German language.
- The 12th century saw the rediscovery **of Aristotle** and his treatises devoted to animals, notably through the commentaries of the Arab philosopher, and in the 13th century, **Ibn al** Nafis, working in a hospital, wrote the "Complete Manual of the Art of Medicine".

The following table represents the chronology and some Highlights from the time of (Antiquity – Middle Ages):

Name of the time	Approximate and symbolic dates	Some highlights of the time	Dynasties
Antiquity	-3500 – 476 (≈ 4000 years)	• Invention of writing (-3500) • Ancient Egypt (-3150 to -31) • Ancient Rome (-753, founding of Rome, to 476, fall of the Western Roman Empire) • Germanic Iron Age (400-800) • Fall of the Western Roman Empire	**Ancient Egypt:** Monarchy (pharaohs) **Ancient Rome:** Monarchy (kings) (-753 to -509) Republic (consuls) (-509 to - 27) Empire (emperors) (-27 to 476)
High Middle Ages	476 – 987 (≈ 500 years)	• The Merovingians conquer Gaul (481-537) • Charles Martel stops the Muslim advance (732) • Troubled change of dynasty (753) • Viking Age (793-1066) • Creation of the Holy Roman Empire (962- 1806)	**Merovingians** (457-751) **Carolingians** (751-987)
Middle Ages Central or Classical Middle Ages	987 – 1328 (≈ 300 years)	• Troubled Dynasty Change (987) • Discovery of America by the Vikings: • Writing of the Roman de Renart (12th -13th century) • Catharism (12th century and 13th century) •"Curse" of the Capetians and change of dynasty (1316-1328)	**Direct Capetians** (987-1328)
Late Middle Ages Or Middle Ages late	1328 – 1498 (≈ 200 years)	• Great inventions and discoveries	**Valois direct** (1328-1498)

IV. THE RENAISSANCE

The Renaissance is a period that takes place at the end of the Middle Ages and at the beginning of modern times. In the course of the 15th century and in the 16th century, this period made it possible to launch many innovations that were popularized, such as the compass or the sextant ; cartography developed, as well as medicine,thanks in particular to the current of humanism. According to English historian **John Hale,** it was at this time that theword Europe entered common parlance and was endowed with a frame of reference solidly supported by maps and a set of images affirming its visual and cultural identity. Science as a discipline of knowledge thus acquired its autonomy and its first great theoretical systems.

The dissemination of knowledge improves: in the 12th century, ancient texts are rediscovered **(Aristotle)** preserved and enriched by the Arabs, then the invention of paper is imported from China to finally culminate with the invention of the printing press (1453) (also imported and improved by **Gutenberg),** and the first printing of a book devoted to natural history dates back to at least 1475. It concerns an illustrated version of the *Buch der Natur* written by **Konrad von Megenberg** in the previous century. This made it possible to distribute more books(manuscript copies took time) and above all to publish books in vernacular languages instead of Latin, thus spreading culture.

Many advances are made in geography and cartography, **Pierre d'Ailly** and *the Imago mundi* from 1410; and map of **Fra Mauro** in 1457. These encourage technical progress around navigation (caravel) and positioning (compass, sextant, etc.). Maritime exploration extends around the African continent (Portuguese), then towards the new world. However, there was indeed a radical change in vision of the world, which focused more on the awarenessby the greatest number of the roundness of the Earth (it had been rediscovered in cultivated circles since the 12th century), from the moment that navigators had crossed the Atlantic. In particular, the voyages of **Christopher Columbus** had a considerable impact.

IV.1 Astronomy:

Directly permitted by the mathematics of the 21st century, astronomy is emancipated from astrology. Solving third-degree equations thus allows **Johannes Kepler** to calculate an earthrise on the Moon. The astronomical discoveries of **Nicolaus Copernicus,** by **Tycho Brahe** and **Galilee** especially, who, at the end of the 16th century,invented the telescope and drew up the first maps of the stars of the solar system, will have the most important repercussions on modern science. Europe passes thus with **Nicolas Copernicus** from a geocentric image of the world to a modern heliocentric conception (the earth revolves

around the sun), froma “closed world to an infinite world” in the words **of Alexandre Koyré.**

IV. 2 Alchemy to chemistry:

Esoteric science since Antiquity, alchemy gave birth, during the Renaissance, to modern chemistry, even if it was with **Lavoisier** especially, in the 17th century, that the divorce will be effective. By proposing a classificationby properties of the elements, alchemy leads to an initially intuitive then experimental knowledge of matter. Many philosophers and scholars are thus at the origin of alchemists, such as **Francis Bacon** or **Pierre Gassendi,** and even, later, **Isaac Newton.** The atomist vision of alchemy will thus be confirmed by the first physico-chemical laws,with **Nicolas Lemery** (1645 - 1715) who published the first treatise on chemistry.

IV.3 The emergence of modern physiology

The medical discoveries and advances made in the knowledge of anatomy, especially after the first translationof many ancient works **of Hippocrates and Galen** in the 15th and 16th centuries allowed advances in hygiene andthe fight against mortality. **Andre Vesalius** thus lays the foundations of modern anatomy while the functioning of blood circulation is discovered by **Michel Servet** and the first artery ligatures are performed by **Ambroise Pare** and **Misha Balabushkin.**

IV.4 Dissemination of knowledge

The field of techniques progresses considerably, thanks to the invention of the printing press by **Gutenberg** in the 15th century, an invention that upsets the transmission of knowledge. The number of books published thusbecomes exponential, mass education is possible, moreover scientists can debate through the reports of their experiments. Science thus becomes a community of scholars.

Finally, the Renaissance allows, for the scientific disciplines of matter, the creation of distinct disciplines and epistemologies but united by scientificity, itself permitted by mathematics, because, according to the expression of **Pascal Brioist :** "the mathematization of a practice leads to giving it the specific title of science”.

The following table represents some outstanding characters of the renaissance (15th - 16th century):

Era name	Approximate and symbolic dates	Some notable figures of the Renaissance
Rebirth ("Transition")	1450–1600 (≈ 150 years)	• **Christopher Columbus** (Italian navigator, 1451-1506) • **Leonardo da Vinci** (Italian polymath, 1452-1519) • **Nicolas Machiavelli** (Italian theorist, 1469-1527), • Nicolaus Copernicus (Polish physician and astronomer, 1473-1543) • **Otto Brunfels** (German botanist, 1488-1534), • **Pierandrea Mattioli** (Italian physician and botanist , 1501-1577); • **Leonhart Fuchs** (German physician and botanist , 1501-1566), • **Nostradamus** (French physician, apothecary and astrologer,1503-1566) • **Andrea Cesalpino** (Italian philosopher, physician, naturalistand botanist , 1519-1603), • **Prospero Alpini** (Italian physician and botanist , 1553-1617), • **Gaspard Bauhin** (Swiss naturalist, 1560-1624); • **Galileo** (Italian physicist and astronomer, 1564-1642); • **William Shakespeare** (English poet, playwright and writer,1564-1616);

Summary:

The Middle Ages, spanning from the 5th to the 15th century, marked the transition from the decline of the Western Roman Empire to the Renaissance and the Great Discoveries. Divided into the High, Central, and Late Middle Ages, this period witnessed the preservation of Greek sciences in the West and significant cultural and scientific developments in the East.

The Western Middle Ages, lasting from 476 to 1492, saw the dominance of theology, leading to a restriction and prohibition of sciences. Notable individuals like Averroes, Michael Scot, and Ibn al-Baitar made contributions despite these challenges.

The Renaissance, occurring in the 15th and 16th centuries, was a transformative period bridging the Middle Ages and modern times. It saw innovations in navigation, cartography, medicine, and the development of humanism. The dissemination of knowledge improved with the rediscovery of ancient texts, the invention of paper, and the printing press. Advances in astronomy, from a geocentric to a heliocentric model, marked a significant shift in worldview. Alchemy evolved into modern chemistry, and progress in anatomy and physiology contributed to advancements in medicine.

The Renaissance facilitated the creation of distinct scientific disciplines, united by scientificity and supported by mathematics. The era allowed for mass education through the printing press, fostering a community of scholars and laying the foundation for modern science.