6

The Middle Ages

6.1 Europe

Traditionally, the Middle Ages began in 476 AD, after the fall of the Roman Empire, and ended around 1400 AD. It represents almost a thousand years of continuous political, social, and religious change, including a schism in the Christian faith between Catholic and Orthodox, the crusades with the development of organized military orders, feudalism and the medieval model of government in which people had access to land and worked in return for that access, and the construction of castles used by rulers to demonstrate their wealth and power with the help of knights, soldiers raised to a new high-ranking military status (Fig. 6.1).

The Middle Ages are often described as an era of ignorance, superstition, and intellectual obscurantism. However, recent studies of the thousand years following the fall of the Roman Empire suggest that there was not in fact an intellectual decline in medieval Europe. On the contrary, there was attentive observation of nature in science and in the arts. Moreover, the first universities were founded during the medieval era in Bologna, Italy, and then in Paris, France, followed shortly afterwards by many more universities in cities all over Europe. And, of course, the scientists of the day were well aware that the Earth was not flat.

During the later Middle Ages, magnificent cathedrals were built in Western Europe, embellished with splendid stained-glass windows. The cathedral of Chartres in France, built around 1200, is a good example of the impressive buildings erected during the so-called "Dark Ages." It is 130 m long and was originally 105 m high (there is now a taller tower), and it was filled

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Fig. 6.1 Medieval Sun. Photo of sunrise with terracotta Sun. In the Middle Ages, the Sun was often depicted with a face

with sculptures representing figures from the Old and New Testaments. The purpose, as usual in those times, was to preach to and instruct the illiterate population about religion. The main feature of Chartres cathedral is without doubt its stained-glass windows, all 176 of them. The purpose of these beautiful windows was once again educational, to preach religion by illustrating the Old and New Testaments. Art was the most effective tool for communication, and I believe, and hope, that it can still be an important tool for communication even in these technological times.

Unfortunately, Notre Dame cathedral in Paris, built in 1163 and completed in1344, was very seriously damaged by a fire in April 2019. This sad event damaged part of the roof and many works of art in the interior. Now the discussion between the many experts centers on how to reconstruct the missing part: reproducing it the way it was originally, or giving the cathedral a touch of modernity.

During the Middle Ages, particularly in Italy, there were many innovative artists. Nicola Pisano, Cimabue, Duccio di Buonisegna, Arnolfo di Cambio, and, especially, Giotto di Bondone, often considered the most important of all. Giotto was born near Florence in 1266 and died in Florence in 1337.

He was a painter and architect and lived at the end of the period sometimes referred to as the "Dark Ages," just prior to the Renaissance. But, in his work, he certainly sowed the seeds of the innovations to come in the Renaissance style of art, which developed a century or so later. His best known works are the frescos painted in 1301 in the Scrovegni Chapel in Padua, Italy. The chapel is almost 30 m long and 13 m high, and the vault of the chapel is painted in an intense blue color to depict the sky with gold stars. There are scenes from the New Testament, and the birth of Christ is depicted in one part of the chapel, with Halley's comet brightly painted over the stable. Very likely, Giotto observed it himself during its passage in 1301. On the large west wall of the chapel, there is a representation of the "Last Judgment," which probably inspired Michelangelo to paint his more famous "Last Judgment" in the Sistine Chapel in Rome. Giotto's Scrovegni chapel frescos are considered one of the finest works of art in the whole of Western culture, and the chapel has been a UNESCO World Heritage site since 2021.[1]

During medieval times, the model of the Universe was Ptolemaic, and indeed, Ptolemy's model was widely used to calculate the positions of the planets relative to the fixed stars. Dante's "Divine Comedy," and in particular "Purgatorio," includes many lessons of astronomy, alluding to the positions of the Sun, Moon, and planets to indicate the time of day. According to Dante, astronomy was the noblest science. In his other work, the "Convivio," as in the "Divine Comedy," there are many astronomical allusions. His understanding and knowledge of astronomy were derived from a commentary on Aristotle written by Albertus Magnus ("On the Heavens"). This commentary was widely known during the Middle Ages, and Dante's "Paradiso" and "Inferno" can therefore be described as Aristotelian in nature.

There were many Italians among the intellectual scholars of medieval times. One of these was Leonardo Pisano, known as Fibonacci, who was born in Pisa in 1170 and died there in 1240. He is remembered as a mathematician, but he was also a rich merchant who was fond of traveling, something that was not so common at the time. In fact, he undertook his journeys a generation before the more famous travels of Marco Polo. Fibonacci traveled for his business, but also through curiosity with regard to other cultures. He went to Algeria in North Africa, where he had contacts with Islamic intellectuals and mathematicians. He was the one who introduced the Hindu-Arabic decimal number system into Europe, where it replaced the Roman numeral

[1] Enrico Scrovegni was a rich man who practised usury in Padua. In fact, he was more of a usurer than an art lover. He commissioned the painting of the chapel in order to be absolved from his sins, a common practice at the time. Wealthy sinners could buy their place in heaven with the complicity of wealthy and just as sinful clergy. Therefore, in his "Divine Comedy: Inferno," Dante placed him in hell.

system. He is famous for the Fibonacci sequence, in which each number is the sum of the two preceding numbers. This is a sequence which often crops up in different areas of mathematics and science today. Fibonacci sequences can be found in natural systems like cells, the petals of flowers, honeycombs, seashells, and many more, including the never-ending patterns of certain fractals.

I have mentioned some of the best known minds of the medieval period, but there were many less well known and just as brilliant. Personally, I think it's unfair to label this period the "Dark Ages." Europe was not really in decline and deprived of intellectual freedom. It is true that the great majority of the population were ignorant and superstitious, but that was the way things were from Antiquity and right through the following centuries.

Castles, knights, dragons, and beautiful princesses like Rapunzel, the best known fairytale princess with her long blond hair, are all part of the idealized image of the Middle Ages. It was indeed a time rich in myths and legends, but there were also substantial changes in society and politics. In Western Europe, the glory and the myths of Ancient Rome were somehow still present, so it was not a total break with the classical period. In the ninth century, the Carolingian Empire of the Franks was based on the ideals of the Roman Empire. The main political change in medieval times was perhaps the construction of castles, the introduction of the feudal system, and the foundation of monastic orders (Fig. 6.2).

There was a proliferation of castles in Europe in the ninth and tenth centuries. These fortified structures were built by the nobility and royalty, or by the military orders. They were offensive and defensive at first, built for military use with the purpose of controlling the territory, and as symbols of power, but they were later inhabited and embellished. Castles were built everywhere in Europe, and many of them can still be seen and admired in our modern countries. In Germany, there are 25,000, maybe more than in any other European country, while in Italy some 45,000 buildings are classified as being from this period, but that includes many watchtowers, which cannot be counted as real castles.

I live in a small medieval village in Tuscany, Italy, surrounded by many castles, but there is one with a particular gruesome story. This is a true story which took place near Bolgheri, a small town near Pisa. The count of Donoratico, Ugolino della Gherardesca, was imprisoned in the tower of Muda with his two sons and two grandsons. Dante rated Ugolino as a traitor, sent to hell, the "Inferno," where he would have to eat the brains of his offspring for all eternity, and indeed, the five unfortunate people never left that tower alive. Nowadays, Bolgheri is still owned by the Della Gheradesca family, and the

Fig. 6.2 Medieval castles and knights. Acrylic paint on canvas with two knights made of iron and holding illuminated glass shields

sad story of count Ugolino has been forgotten. Bolgheri is instead famous for its excellent red wine.

Thanks to the thousands of handwritten books kept in monasteries during medieval times, we now have valuable records of medieval culture. Monks were the guardians of history, science, religion, and art, and the books were embellished with very carefully drawn illustrations. Monastic orders were founded mainly in Italy, but also in the south of France. The Dominicans, Franciscans, Benedictines, Cistercians, Carmelites, and Clarisses were called the mendicant orders because of their vows of poverty. The majority of monastic orders arose in the twelfth and thirteenth centuries, but one of the best known was the order founded by Saint Benedict, in the sixth century.

The Benedictine order had strict vows of poverty, chastity, and obedience. They were allowed no personal property and carried out their daily tasks in silence. The lives of the medieval monks revolved around prayers and work, both manual and intellectual. From the fifth to the thirteenth century, the monasteries were the sole producers of books in Europe, and the monks were involved in every aspect of their production, from writing, to illustrating and anything needed to obtain the finished product. A library was a must in these abbeys. According to the rules of Saint Benedict, monks had to work in silence in a room in which the only light came from a small window. Every day, no matter what the weather or their state of health, the work of the monks had to be done.

To get a feel for the atmosphere in a medieval monastery, the book and the movie "The Name of the Rose" give a perfect example. The story takes place in the year 1327, when a Franciscan monk, William of Baskerville, and his novice, Adso, travel to a north Italian monastery. As soon as they reach the abbey, one cold and snowy day, the story becomes intriguing. The book was written by Umberto Eco and the movie was directed by Jean-Jacques Annaud in 1986. The reader of the book, like the viewer of the movie, immediately gets a feel for what life must have been like in the Middle Ages, witnessing the wealth of the monks, the extreme poverty of the peasants, the heresy, the witchcraft, and the cruelty of the inquisition imposed by an all-powerful church. Then there is the library, a labyrinth containing thousands of manuscripts, carefully copied by the monks, who illustrated them with amazingly detailed drawings and paintings, working every day in their lonely and dark environment. And so goes this accurately constructed scenario describing medieval life in a monastery.

The libraries in the monasteries of Europe tell us how studies of philosophy, theology, art, and especially astronomy were of great importance. Throughout the Middle Ages, astronomy, in particular, was a required discipline for every student. People at that time believed that the radiant Sun, the Moon, the stars, and the planets held a power over their lives. There was no distinction between astrology and astronomy. By carefully observing the twelve astrological signs of the zodiac, astronomy provided a foundation for astrology. Medieval people organized their daily lives from sunrise to sunset around the positions and motions of the Sun and Moon. A manuscript called a miscellany illustrated the cosmic forces by personifying and attributing colors to the celestial bodies: the Sun as an emperor, the Moon as a woman, Mars as a knight, Mercury as a doctor, Jupiter as a bishop, Venus as love, and Saturn as an old man. Each figure is associated with its own particular color: the Sun traditionally with gold, the Moon with green, Mars with red,

Mercury with silver, Jupiter with blue, Venus with white, and Saturn with black.

Science in medieval Europe was closely connected with faith. Ptolemy's geocentric theory was the one accepted by the church. The religious idea of man as the most important of God's creations, with the Earth at the center of the Universe, provided the perfect connection between science and faith, and until the heliocentric revolution of the seventeenth century, medieval astronomers remained faithful to the Aristotelian and Ptolemaic systems.

6.2 Other Parts of the World

Art and astronomy in medieval times were not limited to Europe. Indeed, the monks in monasteries across Europe were not the only ones to produce manuscripts. The Islamic world also contributed significantly to the study of astronomy, astrology, and the arts from a cosmological standpoint. The philosopher Al-Farabi, who lived from 870 to 950 AD, described astronomy through mathematics, music, and optics. He used Ptolemy's studies of astronomy to calculate the Sun's position when viewed from any fixed place.

Astronomy was always a very important discipline in the Muslim world, for practical purposes such as navigation and determination of an accurate calendar, and also for religious purposes, because observations of the Sun and Moon were used to determine prayer times. During the Middle Ages, large observatories were built to observe the sky. The Maragheh astronomical observatory was founded in 1259 under the reign of Ilkhanid Hulagu, and directed by the Persian astronomer Nasir al-Din al Tusi. It included many constructions related to observation of the Sun, as well as a library of some 400,000 manuscripts. Solar observations in Maragheh came under the supervision of the astronomer al Tusi, who worked with twenty astronomers from different countries and more than hundred students. All in all, it was a highly innovative international collaboration between scientists and students.

In the year 1424 an observatory was built in Samarkand, the work of the astronomer Ulugh Beg. It was a monumental building with a very long meridian arc, which was part of the Fakhri sextant, used for observation of the Sun. It had a radius of 40.4 m and was the largest, and indeed the finest instrument of the time. The observatory in Samarkand remained active until 1500 AD, whereupon it disappeared for unknown reasons and was only rediscovered in 1908 following archaeological excavations.

Many other astronomical observatories were built by the Muslims during the medieval period, but many of them were destroyed by natural causes

such as earthquakes, and also by invasions. The Isfahan Observatory was another large one, now in ruins, and in the eighth century, the Muslims built observatories in India. In this period, Muslim astronomers also invented new instruments, and developed others like the astrolabe, an instrument that had been known since Antiquity. The astrolabe was used to calculate the position of the Sun when it rises and when it sets, and also to locate other celestial bodies and to tell the time. It was a key instrument for astronomy, astrology, and navigation. Arabs introduced a better designed astrolabe to Europe in the eleventh century.

Alchemy was widely practised in medieval Europe, but also in the Muslim world, although with a difference. In Muslim culture, alchemy was considered a science of the cosmos and the soul, and as a path toward spirituality in which nature was regarded as sacred. It was related to the practice of astrology, but also to what we now call chemistry. Here, for example, different metals were associated with the different planets.

This was the way Islamic culture moved toward science during the period 900–1400. In Europe, on the other hand, alchemy was viewed almost like magic! It was firmly believed that metals could be changed into gold if only they could find the right recipe.

The approaches of the two cultures were also different in the arts. Calligraphy was the dominant form of artistic expression for Muslims, often used to add verses of poetry on ceramics and the walls of their homes, along with geometric and flower motifs. Early examples of religious art did not contain figurative images, as this was not allowed by Islam, but private residences were filled with figurative paintings, sculptures, and mosaics. Examples of these works can be found in bathing scenes at Qasr Amra in Jordan, built in about 730 AD, and at Khirbat al-Mafjar in Jericho, which are both private residences. Major art forms besides calligraphy were ceramics, books, carpets, metalwork, glass, and decorated scientific instruments, all of them considered by Western cultures as strictly decorative art. Architecture was another important form of artistic expression in many different Muslim countries. Mosques were built in North Africa, Iran, India, and even as far afield as China. Muslim art cannot be considered as confined to a single country, and neither can it be classified as religious art, even though, in those different countries, people professed the same religion. In the Islamic world, the various dynasties in different countries each developed their distinctive style of art.