

## SCIENCE IN MEDIEVAL CIVILIZATIONS

### *Topic 2*

#### **High Middle Ages**

After the liberation of Toledo in 1085 and Sicily during the 11th Century from the Muslim rule, the Latin West came into the contact with the greatest amount of the ancient texts until then (cf. Grant, 1996). They have primarily come from the Greek originals and secondarily from the Arabic translations. Among them the most prominent place was given to the works of the Ancient Greek philosopher Aristotle, who came to be known simply as the Philosopher, because the rediscovery of his works was crucial for the establishment of the Catholic scholastic philosophy, which aimed at the conciliation between theology and philosophy by providing the rational explanations of the religious teachings (cf. Kalin, 1997).

Its main proponent was the Italian Dominican Thomas Aquinas (1225-1274), later declared a saint, an angelic teacher and a doctor of the Church, who in order to achieve the unity between theology and philosophy, has in his *Summa Theologiae* declared that reason could be helpful in approaching matters of faith for which purpose he used the logical syllogisms. Coming from a noble background, he was first destined to become a Benedictine monk, as was then a usual practice with the younger sons from the wealthy families, so he was sent to the famous Monte Cassino monastery in which he got acquainted with the works of Aristotle, Averroes and Maimonides, but at the age of nineteen he decided to join the newly formed Dominican order, which he did despite the strong objections from his family. He studied at the Faculty of Arts of the University of Paris, became a professor of Scriptures at the University of Cologne, finally to return to the University of Paris as a regent master of theology in the two mandates (cf. Crombie, 1959). In his works he stated that although human beings had the natural capacity to know many things, they still from time to time had needed the special divine revelation, especially in regard to the questions of the faith, which he explained as the movement of the intellect by God to its act. He thus claimed that the truths of science cannot contradict the truths of faith, and about the troubling question on world eternity (*de aeternitate mundi*) he said that since any argument of reason proves unsatisfactory only the revelation can offer a secure answer (cfr. *Summa Theologiae*, I, q. 46, a. 2).

His teaching on the usage of the mathematical models in the physical sciences gave rise to a mathematical physics, *scientia media* or “mixed science” whose best examples are mechanics and optics. It was based on the demonstrative syllogisms composed of the two premises, one mathematical and one physical, whose conclusion was a middle term or a metrical concept which expressed the final result of a measuring process applied to a physical entity. It enabled

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a demonstration of the properties of the natural bodies and the inorganic substances, composed of the elements and the compounds, such as the stars and the planets, and thus formed the basis of the natural theology and gave rise to the philosophical movement which in honor of Saint Thomas Aquinas was named Thomism (cf. Wallace, 1996). It has represented a continuation of the Aristotle's teaching on analogy which is a form of reasoning in which one thing is inferred to be similar to another thing in a certain respect, on the basis of the known similarity between the things in other respects. The Aristotelian-Thomistic concept of analogy was crucial in the development of the theology, because it enabled theologians to perceive and describe God through the usage of different analogies, which had already been present in the Old Testament metaphors and the New Testament parables throughout the Bible.

A special place in the Aristotelian-Thomistic thought is given to the problem of matter which per its definition designates all that is directly perceptible by the human senses, meaning “material” that can be seen, heard, smelled, tasted, and touched. As such it encompasses not only the solid objects, but the liquids, the gases, and the things which are indirectly observable with the help of the measuring instruments. One should highlight that although for both Aristotle and Saint Thomas Aquinas “form” was perceived as an incomplete and partial reality or an *ens quo*, it was by the 13th century Oxford Franciscan School instead understood as a complete substance or an ‘*ens quod*’, which has led to a number of contradictions. As the main consequence of the mentioned misunderstanding, the Newtonian physics became “materialist” in its structural description of the cosmos, “mechanistic” in regard of the dynamical and causal explanation of its becoming, and “reductionist” in its approach to the relationship between the whole and the parts. Thus, the misunderstood Aristotelian-Thomistic thought had to become the principal enemy to be fought, from the viewpoint of the modern mathematical and experimental science.

Thomas Aquinas's teacher at the University of Paris, German Dominican Albert the Great (1193/1206-1280), later declared a saint and a doctor of the Church as well, made his own comments on all the known writings of Aristotle, but also on the works of the above mentioned Muslim philosophers Avicenna and Averroes. In this fashion he wrote on theology, logic, geography, botany, zoology, astronomy, astrology, alchemy, physiology, phrenology, justice, law, mineralogy, friendship, and love (cf. Weisheipl, 1980). He has not only studied science from books, but has also experimented with Nature, and has taken from Aristotle the view that scientific method had to be appropriate to the objects of the scientific discipline in the case (cf. Gillispie, 1970). All these translations have enriched the medieval natural philosophers with

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the knowledge of their predecessors. In the case of medicine, they had not just restrained themselves to the translations of the works of Hippocrates and Galen, which had been brought to Europe by Constantine the African (c. 1017-1087), but they had also critically evaluated the mentioned works, the best example of which is Hildegard of Bingen (c. 1098-1197) who had developed her own pharmacopeia based on her convent garden as is explained in her famous work *Physica* (cf. Baum, 2005).

Another important step in the development of the Medieval Latin Science was the foundation of the universities, which not just housed the libraries for the above mentioned translated texts, but also provided a complete infrastructure for the intellectual communities. These uniquely Catholic institutions have been established since the 11th Century. The first ones were Bologna, Paris and Oxford, each of which was entitled as a *Studium Generale*, which meant that they were allowed to teach all four acknowledged medieval sciences, namely philosophy, theology, jurisprudence, and medicine. During time they have become the centers of production and transmission of knowledge. In the case of medicine, especially important were Padua, Salerno and Montpellier, which had introduced the practice of the human dissections in the anatomical teachings (cf. Crombie, 1959).

According to Grant the reason why the universities have appeared only in the Latin West was in the separate existence of the Roman Catholic Church and the different feudal states, each of which was willing to recognize a further separate existence of the corporate entities such as the universities. The mentioned independent relationship between the Church and the State in the Latin West was substantially different from the subordination of the Church to the State in the Byzantine Empire, and the thorough religious prescriptions for all the life activities in the Muslim East, which was best symbolized with the person of the caliph, who was at the same time the highest religious and political ruler. Already in the 13th Century the scholars from different universities have started to tour each other institutions in order to examine the libraries or give the lectures, and thus have consequently helped the spreading of the knowledge and the forming of the uniform intellectual milieu across the Latin West. Through their system of teaching with the lectures based on the readings of the ancient authorities and the disputations developed around the students' thesis based on them, the European universities were at the same time preserving the experience of the previous generations and encouraging the criticisms of the same. Both these circumstances were equally important in the development of a scientific way of thought that has eventually led to the final overthrowing of the ancient authorities during the Renaissance (cf. Grant, 1996).

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