

Summary of 8.6 "Production: Learning and Experimentation"

The major part of our discussion was on the position of Islam towards science and how it encouraged the use of senses, reason and experimentation. We indicated that the experimental approach was not introduced to the West by Roger Bacon but that it was known to Muslims centuries before him when they used it effectively. The scientific progress that was achieved started with the revelation of the Quran, during the first four Caliphs after Muhammad (PBUH) and continued through the Umayyad Dynasty and had its Golden Age during the Abbasid Dynasty and the Umayyad Dynasty in Spain. There were thinkers in education and science who belong to different areas such as schools, mosques, city libraries and big academies (example: famous House of Learning established in Bagdad in the 9th century). The main problem here is that the European Renaissance was not based as some believed on the revival of the Greek but it was very much influenced by Muslim science.

8.7 Muslim Contribution to Astronomy and Chemistry

Host: Could you expand on the influence of Muslim science on the European Renaissance?

Jamal Badawi:

In fact one of the astounding and useful references on this subject is a book by George Sarton called The Introduction to the History of Science, a very comprehensive work composed of several volumes. In it he indicates that one of the main reasons universities sprung in Europe was that there were so many sciences coming from the Muslim world that the mass of this information required some type of systematic study. This is why universities were established in Europe. It says that this goes back as far as the 12th century so the contact and immersion

took place before that time also. Robert Briffault in his book *The Making of Humanity* says that “it is highly probable that but for the Arabs (he means the Muslims) modern European civilization would never have risen at all” He also says “there is no single aspect of European growth in which decisive influence of Islamic culture is not traceable.” Also, “what we call science arose in Europe as a result of a new spurt of inquiry, a new method of investigation of the methods of experimentation, observation, measurement, of the development of mathematics in a form unknown to the Greeks. That spirit and both methods were introduced into the European world by the Arabs.” It is not quite correct to interpret the term “Arab” from an ethnic sense at all. Many writers refer to the term Arab synonymously with the term Muslim which is not a very accurate term unless we take it in the spirit expressed by Prophet Muhammad (PBUH) that any person who speaks Arabic is an Arab (not just ethnicity). In the epoch of Muslim civilization every Muslim regardless of his or her mother tongue also knew Arabic it being the language of civilization, the language of scripture, the language of science.

Host: Did the Crusades play a role in European Renaissance?

Jamal Badawi:

The tragic part of the Crusades is well known for the kind of devastation it brought to the Muslim world. It still appears that there were side effects from the Crusades just like with any war and that it contributed a great deal in providing an opportunity for getting the Muslim sciences and knowledge to the West. Dr. Dudley B. Stevenson a historian who wrote a chapter in Volume 4 of *The Universal History of the World* said “learning an art and science of the East (Muslim World), its public services and method of government, its highly developed industries and the superior luxury and comfort of the domestic life in its upper classes exerted a powerful and far reaching influence up Europe in the Crusading period.” Another historian Henry Barns in discussing the consequences of the Crusades in Volume 1 of *The History of Western Civilization* says that “Westerners learned many Muslim and oriental ways developed a taste for

the luxuries of the region. All of this promoted a demand for Eastern goods and accelerated the growth of commerce. The Italians who had acted as transporting agents for the Crusaders took full advantage of their opportunities to build up trading relations with the East.” In another place he adds “the science and culture of the Muslims were brought back to Europe and helped to create a remarkable intellectual revival of the twelfth and thirteenth century. George Sarton said in *The Introduction to the History of Science* “one of the results of the Crusades was the reintroduction of public bathing places in Europe” and he discusses steel bath which was introduced by Muslims and brought to Europe with the Crusaders. It would be useful to remember that the period of the Crusades was not all two centuries of fighting in battle fields. There were periods of truce, of relative peace, periods of intermingling and mixing between Muslims and Christians (even between the invaders and conquerors) and there were incidents where human relations could had been established between them. In fact many historians refer to places like Sicily in Syria where there were a great deal of person to person intermingling between Muslim scientists and learned scholars and the invading Crusaders. In fact in Spain intermingling included Muslims, Christians and Jews as some historians described to be unrestricted unrestrained contact. The result was a great deal of information exchange, but mostly adaptation of Muslim sciences and brining it to the West. In the case of Spain the result was untold prosperity which was never presented before nor surpassed ever since.

Host: Could you give us examples or illustrate the point that Spain was the most prosperous it had ever been?

Jamal Badawi:

In “The Falcon of Spain” written by a Canadian Muslim Dr. Thomas Irving and in “The Story of the Moors in Spain” by Stanley Lane Poole in which we find many fascinating things that it is difficult to believe that at one point in time these things really took place. Poole says in his book that “for nearly eight centuries under her Muhammedan (it should be Muslim but this is what he used) rulers Spain set to all of Europe a shining example of a civilized and enlightened state. Her fertile provinces rendered doubly prolific by the industry and engineering skill of her conquerors, bore fruit a hundred fold.” In another part he says “art, literature and science prospered as they prospered no where else in Europe. Students flocked from parents in Germany and England to drink from the fountain of learning which flowed only in the cities of the Moore. The surgeons and doctors of Andalusia were in the vein of science. Women were encouraged to devote themselves to serious studying and the lady doctor was not unknown among the people of Cordoba. Mathematics, astronomy, botany, history, philosophy and jurisprudence were to be mastered in Spain and Spain alone.” In another place he says “whatsoever makes a kingdom great and prosperous, whatsoever refinement in civilization was found in Muslim Spain.” Finally he mentions the sorry and sad end of all of this civilization “in 1492 the last bulwark of the moors gave way before the Crusade of Ferdinand and Isabelle and with Granada fell all of Spain’s greatness.” The very fascinating aspect of this is a description by John William Draper in The History of the Intellectual Development of Europe in the second volume on pages 30-31 “Cordoba under their administration (Muslim administration) at its highest point of prosperity boasted of more than 200,000 houses and more than a million inhabitation. After sunset a man might walk through it in a straight line for ten miles by the light of the public lamps. Seven hundred years after this time there was not so much as one public lamp in London. It’s streets were soddedly paved, in Paris centuries subsequently whoever stepped over his threshold on a rainy day stepped up to his ankle in mud.” He indicates that it was not just one exceptional city that was so prosperous like Cordoba he indicates that there were so many other cities in Spain like Granada, Seville and Toledo which considered themselves as rivals to Cordoba. The development and prosperity of Cordoba is just unbelievable. Some historians add to the figures the one million inhabitants and the nearly 260,000 buildings, homes and shops: 3,300 markets, 700 public places, 500 mosques (it was customary to attach a school to the mosque) 28 suburb (we think that suburbs that is something new but it was not in the case of Cordoba). In addition to this they had “countless libraries” (both public and private) in the words of one historian. So the story of Islamic civilization and prosperity in Spain is beyond description. We are talking now the population of Cordoba is not even 1/20th of the population that it at one time was with all that progress.

Host: What are some specific contributions in various fields? and specifically

astronomy?

Jamal Badawi:

Astronomy was one of the earliest fields in which Muslims took interest and contributed a great deal. Some of the most prominent scholars are people like Abu Al-Wafa, Al-Battani, Al-Biruni and Uligbage. Muslim astronomers were the first to discover the sun's apogee which is the point farthest from the earth in the orbit of the moon. They made catalogs and maps of the stars and they gave them Arabic which are still used today. They corrected the sun and moon tables and fixed the length of the year. In fact as early as the 11th century Omar Khayyam known in the West as Khayyam, and who is connected mainly with poetry but who was also a prominent astronomer. Khayyam made a calendar which many historians regard to be more accurate than the Gregorian calendar. Muslim astronomers were the first to use the pendulum in measuring time. Some of those who traveled to the Muslim world came back with a great deal of fascination why they described how clocks worked using the pendulum. The sun dial was invented by Muslim astrologers. As Draper puts it "the most valuable of all chronometric improvements were made by Muslim Astronomers." As early as the 8th century during the Caliphate of Al-Mansur we find that interest was shown in astronomy in different parts of the Muslim world, which was quite vast at that time. We find that many observatories were built. Muslim astronomers were able to use their knowledge to predict or forecast the sun spots, eclipses and the appearance of comets in the sky. One of the great names I mention earlier was Abu Alwafa who discovered the third lunar inequality which deals with the concept of the irregularity of the moon's highest latitude. This very important discovery was attributed by mistake 1000 years later to a Danish scholar by the name of Tycho Brahe. I also mentioned Al-Battani who's name in English is quite adulterated and written Albategnius which is difficult to detect and relate. Al-Battani was regarded as one of the 20 most important astronomers in the world. Al-Biruni acted as a link between the astronomy school in Bagdad which is now in Iraq and in India and lived in the court of Mahmoud Ghaznawi towards the end of the 10th century and the beginning of the 11th century. He compiled a table showing the longitude and latitude of the principle cities in the world. Uligbage work was published in the early 15th century and in it he provided a very comprehensive survey of the state of knowledge of Astronomy in his time and that was 100 years before Kepler tried to relate the knowledge of astronomy of the past to his time.

In Muslim Spain as we mentioned earlier prosperity went hand in hand with scientific development. Two bright example are Ibn Khaldun and Ibn Al-Rushd but unfortunately many of their works were lost in the period of reconquest and the ensuing religious persecution.

Host: Can we move onto the field of Chemistry and what role did Muslim scientists play in this particular science?

Jamal Badawi:

As John William Draper clarified that the Muslims should be regarded as the originators of scientific Chemistry. He said that they discovered the most important reagents in Chemistry like Sulfuric Acid, Nitric Acid and Alcohol and they were the first to publish pharmacopeia. One of the great figures in Chemistry goes back to the 8th century, known as Jabr, who lived at a time where the strongest acid known was concentrated vinegar. It was during his time and through his effort that he discovered Nitric Acid. Muslim Chemists were able to describe and understand the operation of distillation, sublimation, filtration, coagulation, crystallization things that are thought to be more modern but were already known quite early to Muslim Chemists. Another great name in Chemistry is Abu Bakr Al-Razi which is written Rhazes in English who used to be the physician and chief of the hospital in Bagdad in the 9th century. He was said to be the first to describe the properties of Sulfuric Acid. The contribution in his time by Muslims to the study of Chemistry was described by William Draper as “ as important in magnitude as those of Lavoisier and Priestly.” In addition to this we find that Muslims were first to use gun powder in as early as 1342 which is quite a period of time before Roger Bacon. Another Muslim Chemist who lived towards the end of the eighth century, Abu Musa Al Kuhl, wrote so many works in Chemistry some of which were translated into Latin. One important work of his “The Sum of Perfection” was translated into French in 1672 (almost 800 years after his death).

These contributions reflect the practical state of inquiry that Muslims have learned through the motivation provided in the Quran. They understood theoretical Chemistry and were quite prominent in applied Chemistry. It suffices to say that in those early times they knew of distilled water, plasters and syrups (pharmacists and doctors can appreciate the important role of syrups in the preparation of countless drugs). They were able to use ointments for the cure of certain diseases. They knew about dyeing clothes and textiles, tempering steel, curing leather which are definitely aspects of applied chemistry. Many of the terms in English or other European languages of many chemical material substances names originate in Arabic. For example “camphor” which is cafor which is the same thing. Alcohol was as we indicated earlier a Muslim invention which is an Arabic word. Alexeer in Arabic is elixir in English. Alkaloid comes from khaloi in Arabic. These are only a few examples of numerous chemical substances that were discovered and prepared by Muslim Chemists.