THE JOURNEY OF IDEAS

CHAPTER 1

1. SCIENCE AS A TRANSCULTURAL ENTREPRISE

From the dawn of history, astronomy has played an important role in human development. The beauty, regularity and persistency of the starry night sky have been a source of wonderment. The ability to predict the motions of the Sun, planets and stars were decisive factors in the emergence of agriculture and navigation in early civilizations. Mathematics, geometry and the first measurement instruments were developed and used to measure accurately stars in the sky. The interplay between observations and explanations triggered ideas that eventually led to the development of modern astronomy and space exploration astronomy. These ideas were however not developed in a single place, but made a long journey through many countries, where they met other ideas from other cultures, became enriched and triggered new ideas. This is the story of this journey.

1.1 The journey of astronomical ideas

In prehistoric times observations of the sky led to the discovery that several objects in the sky moved with a regularity that could be predicted. The Sun rose and set periodically. The Moon changed its shape and the shapes repeated. Groups of stars were visible sometimes and disappeared to become visible again at a later time.

In Babylon and Egypt the first astronomers started to measure and record their observations. They made use of the observed regularity to measure time and make calendars. Astronomy was used for fixing the time of religious festivals, for letting farmers know when to plant crops, for helping sailors to navigate their ships and for the collection of taxes. For many centuries the Babylonian, Egyptians, Chinese, Indians and Mayas used astronomy in this way as a practical tool, they sometimes also projected their gods onto the sky, making them responsible for all earthy events including weather, earthquakes, rain, births and death.

As time passed by many cities in the Middle East and around the Mediterranean Sea became important meeting centers, especially those located near harbors or at the crossing points of trade routes. Lots of merchandise, instruments and ideas were exchanged in these places. Within these different cultures astronomy was a tool that made daily life and the organization of the growing cities easier to handle.

However something special happened in the 6th Century BC in the Greek harbor city of Miletus (today´s Turkey). Another way of thinking and approaching the world arose among a small group of people. Thales, often called "the first philosopher", attempted to explain natural phenomena without reference to religion, mythology or connections with the practical use of his ideas. He asked himself about how the world was made and suggested that water was the basis of everything. He also explored rules and relations in geometry and mathematics, again without any practical purpose. By emphasizing the value of knowledge for its own sake, he can be viewed as laying the cradle of modern science.

The ideas of Miletus were brought to Athens, where they inspired the philosopher Aristotle in the 4th Century BC to define the fields and the methods of logic, metaphysics, mathematics, physics, biology, botany, ethics, politics, agriculture, medicine, dance and theatre. His work was used later by astronomers in Alexandria and Rhodes (among them Hipparchus, Eratosthenes and Ptolemy) to give astronomy an inquiring character by posing problems and exploring the sky through observations. Astronomy had previously proved itself to be an important tool in agriculture, navigation and religion. Now it started to have a value itself as a science to obtain knowledge about the world in which we live.

1.2 The role of the Islamic culture in the development of science

After conquering Greece in 146 BC, the Romans never developed an interest in following the scientific tradition initiated by Greek astronomers. In the 4th Century AD. Christianity became the official religion of the Roman Empire, 200 years later all pagan books (including the Greek texts) were forbidden by the Emperor Justinian I. By that time people that belonged to a small Christian sect called the Nestorians1, that had also been prohibited, fled eastwards, settling in Persia (today´s Iran). The Nestorians, who placed an enormous value on science, took with them the most precious books of Greek astronomers. The Greek legacy was received with eagerness and great interest by Persian astronomers, who themselves had a long tradition of observing the sky. The Nestorians were the first civilisation to initiate the journey of astronomical ideas from West to East!

In the centuries after the death of Muhammad, Muslim armies brought a huge part of Asia, North Africa and Europe under their control, including India, Persia and Spain. After the fall of the Persian Empire in 651 AD, the ancient Greek texts were brought to Baghdad. Once

there, they were translated into Arabic by scholars under the mandate of the Abbasid caliph Harun al-Rashid (786 to 809) at the House of Wisdom, a major intellectual center in Baghdad.

The inauguration of the House of Wisdom marks the beginning of the Islamic "Golden Ages" which lasted from the 8th to the 14th Century. Knowledge and advances in the fields of astronomy, mathematics, engineering, navigation, geography, medicine, architecture, chemistry, gardening, finance and poetry were spread over a vast region of the Islamic world that extended from India to the South of Spain. Arabic became the language of science and the huge Islamic empire was used as a connecting corridor, not only for trade, but also to compile, exchange and communicate knowledge. The power of rational thought and debate, previously championed by Aristotle in Athens was rescued and treasured by the Muslims, who applied this way of thinking not only in science but also in philosophy and religion.

From the seventh to the 13th century AD, the Islamic world was ruled by several dynasties of leaders or "caliphs", who were considered to be religious successor to the prophet, Muhammad (see the table below). These dynasties were characterized by their openness to diverse views. They cultivated and valued science and the acquisition of knowledge. The Islamic culture of that time was called "the culture of ambiguity"2. It allowed diverse and sometimes contradictory norms, thoughts and beliefs, to coexist. Also, solving practical problems in the areas of public health, hygiene, water supply, food and education were important goals of this society.

In Spain, the Muslim´s open spirit led to the foundation of important schools that furthered the translation of scientific texts, such as ones in Cordoba and Toledo. Muslims, Christians and Jews worked together in these schools to facilitate the most intensive exchange endeavor of that epoch. The Islamic schools in Cordoba and the book market of the city employed dozens of women, whose job it was to copy and translate texts. Educated women worked as teachers, librarians, doctors and lawyers.

Important accomplishments of the Islamic scholars were gathering together existing scientific texts, translating them and communicating them throughout the Islamic world and beyond. Thanks to the dedicated work of the translation schools Europe recovered not only the thoughts of the ancient Greek philosophers, such as Aristotle and Plato, but received impulses from Islamic thinkers in the key fields of medicine, physics, mathematics and astronomy. Many experts claim that the European renaissance from the 14th to the 17th century was triggered by the influence of Islamic culture3,4.

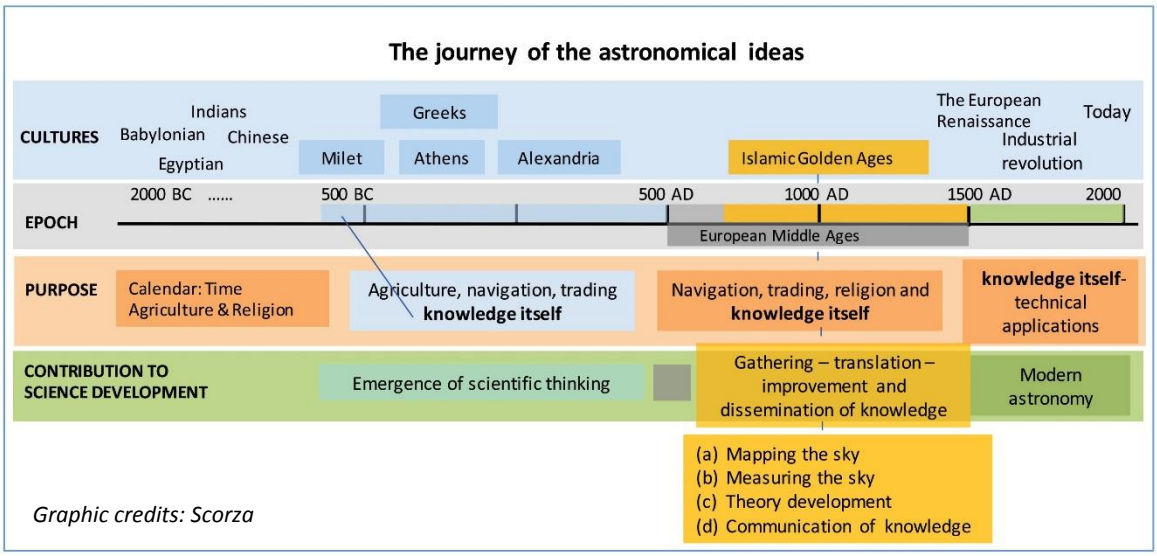
During the golden ages Islamic scholars also made fundamental contributions themselves to the development of astronomy. Examples of these innovations include:

(a) Mapping the sky with the constellations as a reference

(b) Measuring the positions of objects in the sky with instruments

(c) Development of a theory to explain light (optics)

(d) Communication of astronomical knowledge to the public



1.3 The Islamic astronomy heritage kit

The Islamic astronomy kit tells the story of the astronomical ideas that arose in ancient Babylon and Egypt, met in Millet, moved to Athens, and were further developed in Alexandria and Rhodes. After they were forbidden by the Roman Emperor Justinian I, the ideas found a safe place in Persia and later in Baghdad, where they were translated, further developed and disseminated for 800 years by Islamic scholars.

The kit will guide you through the long and exciting journey of these ideas. Each section begins with an own introduction describing the historical context and the open questions driving research. By means of storytelling and activities, pupils are invited to rediscover the early instruments constructed by Islamic scholars and follow the development of the ideas that gave rise to modern astronomy.

Four Islamic scholars, two women and two men, were chosen as representatives of the Islamic contribution to the development of astronomical knowledge: the astronomer Al-Sufi from Rayy (Persia), the instrument maker Miriam Al-Astrolabiya from Allepo (Siria), the physicist Al-Haytham from Basra (Iraq) and the founder of the first university of the world Fatima Al-Fihri in Fes (Marocco).

Al-Sufi *Miriam Al-Astrolabiya* *Al-Haytham* *Fatima Al-Fihri*

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Below are some of the Islamic dynasties that played a major role in this journey of astronomical ideas:

Dynasty	***Period***	***Important regions / Cities***	***Important scholars***
Ummayad	661 - 1031	*Conquest of South Spain, Persia and Northwest India*	*First translation schools in Córdoba and Toledo, Averroes, al-Bitrudschi (Spain 1190)*
Abbasid	*750 - 1258*	*Opening of the House of Wisdom in Baghdad*	*Al-Sufi, Miriam Al-Astrolabiya*
Fatimid	*969 - 1171*	*Cairo (Egypt) as Caliph place*	*Al-Haytham*
Ayyubid	*1171 - 1250*	*Cairo (Egypt), conquest of Syria and Mesopotamy. Recovery of Jerusalem*	*Ibn asch-Schatir (astronomer of Damaskus).*

Activity 1: The map of the Journey of ideas

Ages: 8 to 14

Brief description

The activities on “the map of the journey of the ideas” invite pupils to identify with figures the places where the first ideas about the sky, the Sun, the Moon, the stars and movements of the planets arose, and to follow their journey from Babylon and Egypt to Greece, then to the Middle-East, and from there through North Africa to the south of Spain. By means of these activities the pupils can visualize the Islamic world as an extended corridor in which many ideas and inventions traveled, were exchanged, translated and further communicated to new generations.

Learning objectives and skills

Pupils summarize and link what they learn in each chapter to key historical figures and their astronomical achievements by placing them on the geographical and historical context of the

map. In doing so they discover that the scientific endeavor is a transcultural activity and realize the role played during the Islamic olden Ages in building a bridge between the Greek ancient scientific tradition and the European Renaissance.

Materials

- Map of the Journey of Ideas
- Set of cards related to each chapter (cities, figures and instruments)
- Arrows to be placed on the map to visualize the journey

Image credits: Foundation for science technology and civilisation & 1001 inventions, modified and adapted by Scorza

Full activity description

After introducing pupils to the topic of each chapter and after performing the activities therein, the pupils are asked to place each set of cards on the map containing:

(a) cities,
(b) scholars
(c) instruments.

The pupils can then be invited to explain to the group what they know about these cities, scholars and instruments. The solutions are given in each chapter, with images of the map containing the correct locations of the cards.

These sets of cards should be introduced separately after explaining the corresponding chapter, but at the end the pupils should be able to work with all cards and reconstruct the complete journey of ideas.

Literature

1. John Freely, "Alladdin´s Lamp", 2009 in Editorial Alfred A. Knopf, New York
2. Thomas Bauer, „Die Kultur der Ambiguität", 2011, Verlag der Welt Religionen
3. George Bossong, 2011, „Al-Andaluz, a golden dream", Zeit Middle Ages
4. George Saliba, 2011, Islamic Science and the Making of the European Renaissance, MIT Press
5. The journey of ideas, PDF-document of the Foundation for science technology and civilisation & 1001 inventions

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