

# Guidelines for a Social History of Astronomy

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**ABSTRACT** An analysis of the basic cultural, historical and social elements which allowed the re-discovery and transfer of astronomical knowledge, from the earlier Middle Age up to the birth of modern Astronomy, is presented in the new book *Storia sociale dell'Astronomia* (A social history of Astronomy, in preparation, *La Città del Sole* Eds.). The book describes the main factors which played a role in suppressing or re-awakening interest in astronomical observations and events down the centuries. Among such elements we include: the loss of Greek language knowledge as a vector of scientific knowledge; Christian and Islamic conceptions of Astrology; religious practices connected with observations; the birth of universities; the protestant paradigm and humanism; the evolution of the social figure of the scientist in the West, from monks to aristocrats, and from Renaissance lords to bourgeois entrepreneurs. I focus attention on the social phenomena which caused the development of astronomy as a science from the Middle Ages to the Copernican revolution, and claim that **the ruling class attitude towards science is not only a matter for historical studies, but has much to do with the modern impoverishment and stagnation of Astronomy.**

In this poster we mention selected historical phases/aspects/individuals to stress the importance of the social background motives for the evolution of Astronomy.

In our book *Storia sociale dell'Astronomia* we deal with further cases, and in more detail; we also shed some more light on Astronomy beyond Europe and the West – e.g. in the Chinese Empire. We easily start from **the collapse of the Western Roman Empire and the consequent loss of Greek language** as the “scientific communication” vector.

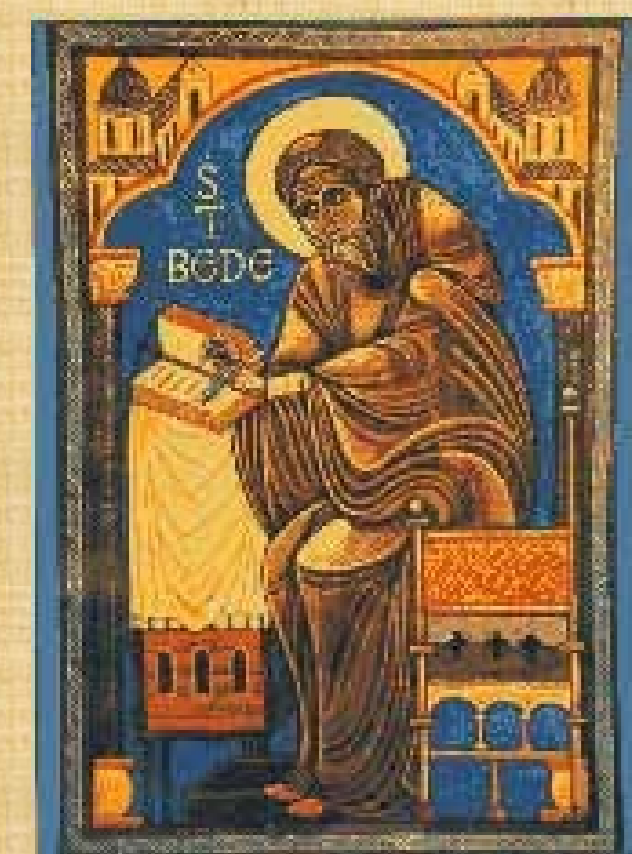


## MAIN STAGES OF THE ASTRONOMICAL KNOWLEDGE TRANSFER – 8-13th cent.:

Roman Empire culture was a basically bilingual one, where Greek language was known by literate people as well as the Latin one. Most of the classic scientific literature was written in this language, typically used for science as it is English today. In Western Europe, when the Roman schools disappeared, the Greek language went lost. Thus the astronomical knowledge went also lost - apart from a minor number of texts, written in Latin (today we should name these works “popular science”) and in particular the ones of **Plinius, Macrobius and Martianus Capella...**



The School of Athens by Raffaello



### The role of Christian religion and church

The schools of monks were not interested in research, since their teaching was based on the principle that the whole truth was written in the Bible and the knowledge of natural phenomena was only useful to better understand the Holy Books. However, the spreading of the Christian religion in the West *did* play a role in the birth of a modern scientific thought. First, being **monotheistic** it wiped away the multitude of godheads and spirits that the ancient world used to associate with natural phenomena, paving the way to “science” for explaining them. Already in the 7<sup>th</sup> century, **Isidorus, Bishop of Seville**, in his work “*Ethymologiarum libri XX*” stated that natural as well as human phenomena can be all described independently of any mythical explanation. He also introduced the important **distinction - ignored by classical science - between Astronomy and Astrology** - the latter, being in contradiction with the basic Christian principle of “free will”, should be considered as superstition.

Further, Christian liturgy demanded the solution of a number of problems connected with **time reckoning** - e.g. for computing the date of Eastern or the « canonical hours » (to perform the due liturgical functions). In 725 the British Benedictine **Beda Venerabilis** wrote “*De temporum ratione*”, a masterpiece of mathematical astronomy.

Monks thus became assiduous and careful observers of the sky. A significant role in what could be defined as “monastic observational astronomy” is due to Irish monks, who transferred the traditional Celtic care for sky observations into the Christian environment, and diffused this knowledge in the whole Western Europe where they established many new monasteries. **St. Patrick** himself is author of astronomical books.

With the so called “Carolingian Renaissance”, the careful observation of the sky became a habit also for the “Schools of the Cathedrals”, where also laymen were admitted. In these schools the “secular” part of the formation included the **“Seven liberal arts”**, one of which was Astronomy. Of course, their teaching was based on the Latin texts cited before, but it was integrated by experimental practice. Furthermore, the larger availability of economical resources allowed the “Schools of the Cathedrals” - incubators of the Universities that were established in the following centuries - to introduce the first astronomical instruments used in Europe since the end of the Roman Empire: they were just tubes, used to insulate the star in the viewing field and to measure its alt-azimuthal coordinates. Their use is a proof of the increasing interest for the precision of the observations.

### Islamic culture and its influence in the West. The 12th-century revolution

It was Islam which allowed the **rediscovery of Ptolemaic astronomy** also in Europe. It is, e.g., everywhere known as “*Almagest*” - from the Arabic “*al-Magisti*” - the major astronomical work of Ptolemy, whose first Arabic translation from Greek was done by **al Haggiag ibn Yussuf ibn Matar** in the 9<sup>th</sup> cent. by order of the Abbasid caliph **Harun al Rashid**. The recovery of the classical astronomy was immediately followed by the resumption of the experimental activities. For instance, to the caliph **al-Mamun** and to his team of astronomers led by the famous **Ahmad al-Farhani (Alfraganus)** are due the building of two astronomical observatories and two extraordinary astronomical exploits: the extremely precise measurement of the Ecliptic obliqueness as 23° 33' in 830 AD and that of the meridian degree in 828 AD. Worth of special mention is the work of **Nasir al-Din al-Tusi (1201-1274)** and of his team (including even a Chinese astronomer!) of **Maragha Observatory**, in Persia, where a careful process of analysis and **revision of the Ptolemaic model** was performed. This work, often properly named “**Maragha Revolution**”, demonstrated the incompatibility of the hypothesis of non-uniform motion and of the introduction of the “equant” with the Aristotelian principles that were at the basis of the Ptolemaic model. It is very probable that that Copernicus' work actually started from the al-Tusi's one, given the analogy of the demonstrations used.



It would be too long even to simply name all the great Islamic astronomers, from **Avicenna** to **Ulugh Beg**, and to list all the paramount developments of Astronomy in Islamic world, from the 7<sup>th</sup> to the 14<sup>th</sup> century.

Here we just mention the **main possible reasons for this flourishing**:

\* **religious needs**: the prayers to be done at fixed times and in the direction of Mecca (*Qibla*) and the beginning of *Ramadam*, determined by astronomical conditions.

\* **nature of Islamic civilization**: a tolerant society, ready to assimilate the best of other peoples' knowledge – e.g. it has been stated that the origin of Islamic astronomy is related to the gift, in 772 AD, of an astronomical book by some **Hindi scholars** to the Caliph of Bagdad **al Mansur**, who immediately ordered to **Ibn Ibrahim al Fazari** to translate this book (named in Arabic *Zij al Sindhind*, i.e. *Hindi astronomical tables*) with the help of the same Hindi scholars. Also the role of **Zoroastrian and Sabian cultures and religions** has to be taken into account: e.g. **Al-Sabi Thabit ibn Qurra al-Harrani** (826 - 901), translator of the Euclid's “Elements” and renowned astronomer, was a Sabian.

\* **stronger interconnection between Astronomy and Astrology than in the classical world**: although Islam doesn't accept any form of divination, it is a matter of fact that all Islamic astronomers were also astrologers (possible reasons for this are given in our book).

\* **most probably, the main reason why astronomy became the most important science in the Islamic civilization is to be related to its origin by Arabic nomadic people**, traveling through the sand desert of Arabia, where no geographical reference points are visible and the stars are the only reliable reference.

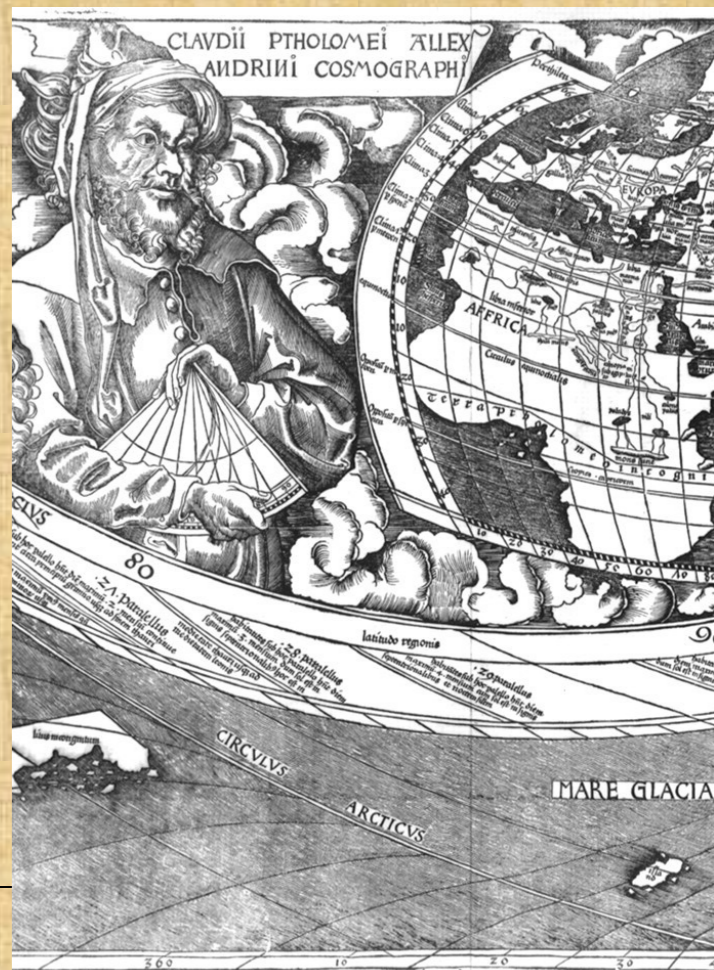


The **Arabic astronomical knowledge and the related observational techniques soon started to reach Europe**. As long as in 1050, the Benedictine **Hermann of Reichenau** wrote a book on the **astrolabe**. Islamic influence on Western astronomy (and on knowledge as a whole) became of paramount importance during the **12<sup>th</sup> century**: despite of the Crusades, between Western Europe and Islam there was not only a clash, but a fruitful encounter too. In this framework, the role of Emperor **Frederick II** (1194-1250) as a highly innovative ruler and intellectual is well known, for his being *trait d'union* between Christian and Islamic civilizations as well as a promoter of the dawn of “secular science”. Frederick II did not left us any text on Astronomy, but his point of view, fully inspired by Islamic Ptolemaic Astronomy and Astrology, on this field is shown through the architectural design of his castles. For sure, Frederick II was the sponsor of **Leonardo Fibonacci** and **Michael Scotus** – the latter being the scholar who **reintroduced Astrology in European Astronomy**. Most probably, the inclination of Frederick II towards Astrology derived not only from his admiration for the Islamic culture, but also from his **opposition to Papacy**. This reintroduction must not be seen only as a cultural involution but also as one of the reasons for the subsequent impetuous development of Astronomy.

As a matter of fact, there was no difference between Astronomers and Astrologers until the 17<sup>th</sup> century. After Astrology was reintroduced in Europe, **Astronomy became a lucrative and respected profession**: the number of astronomers, and thus the number of astronomical Studies and results, started to increase. Another major reason for this was the need of astronomical knowledge raised by **the development of long-range navigation: the times of great geographical “discoveries” (and colonial conquests) were approaching**.

In the same epoch, **Universities** were founded in several European towns. Their aim was to educate the new ruling classes: not only clerics and nobles, but also bourgeois.

## FROM CLERICS TO LORDS TO CRAFTSMEN AND BOURGEOIS -



### Astronomers from the 13th cent. onwards:

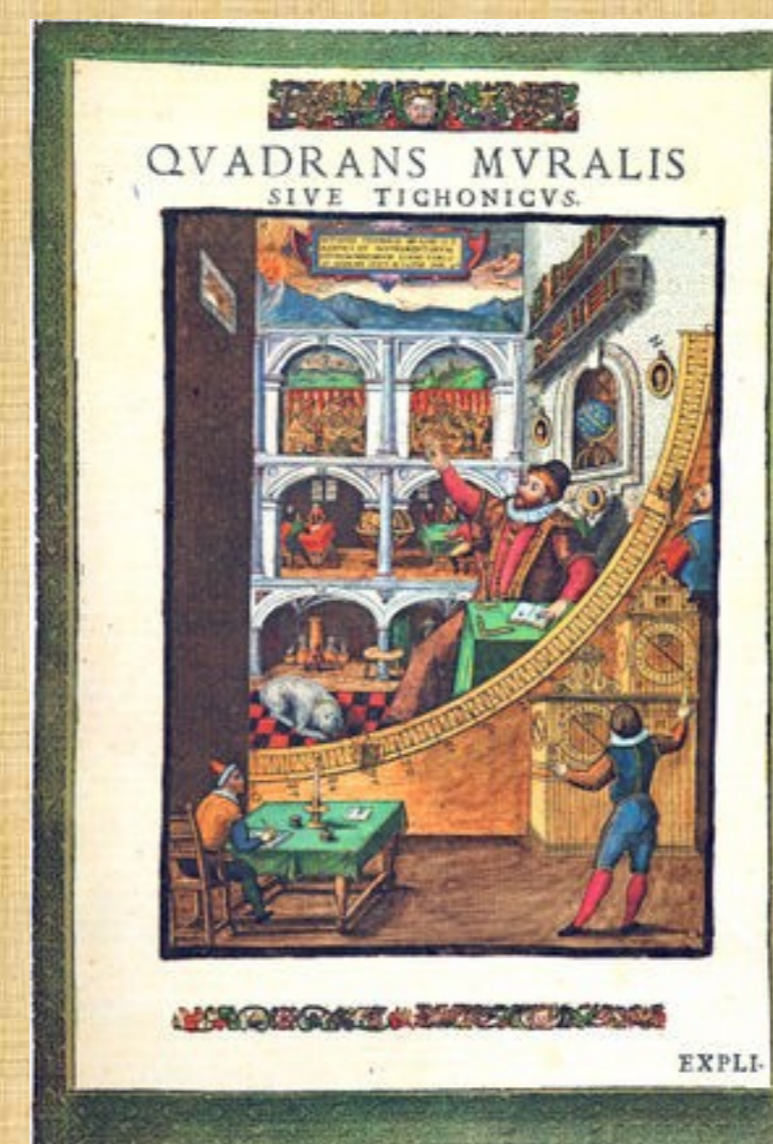
**Roger Bacon**, “**Doctor Mirabilis**” (ca. 1214–1294), was still a Franciscan Friar, but studied at Paris University and became an independent scholar. Among his many cultural interests (he was e.g. a true expert of Islamic science) was Astronomy too: his *Opus Major* also deals with the positions and extensions of the celestial bodies, including the clear stating of the **Earth's roundness** and some criticism on the Julian calendar. Bacon was condemned by his Order in 1278, most probably due to his involvement in Astrology and Alchemy. More in general, his “fault” had been to be a critic of the “authority principle” and to believe **experience to be the mean to get the knowledge of Nature**. But his attitude represented a clear step towards Humanism.

### Renaissance: practices, thought, social roles

A crucial role in **changing the paradigm on the Universe – from finite and Earth-centered, to infinite and isotropic** – was played by **Thomas Bradwardine** (14th cent.) and **Nicholas of Cusa** (15th cent.), who at the same time enjoyed and contributed to the new cultural atmosphere. But when **Giordano Bruno** came back to the point (end of the 15th cent.), the *Controriforma* had taken place... and he had to defend his ideas till death.

The development of scientific procedures for **cartography** is an example of the whole epistemological process which characterized Humanism and Renaissance: just like so-called *cosmographers* started communicating with sailors, all **philosophers started to appreciate empirical experience acquired by technicians, thus becoming scientists in the modern sense**. In particular, astronomers soon started to work together with artisans: joiners, mechanics, all sorts of craftsmen... The main case is the one of **Tycho Brahe (1546-1601)** with his many collaborators assisting him in the **Uraniborg and Stjerneberg observatories**. Tycho, a powerful Lord, is the model of a Renaissance intellectual: an individual who was *master* in the - now *fully human* - enterprise of understanding the universe.

**Empirical experience** was thus getting unprecedented appreciation in the western culture. A key role in this cultural process was played by the **Protestant movement**, because of self-evident reasons. Tycho was a protestant; moreover, while **Copernicus (1473-1543)** was himself catholic, the main backers, popularizers and refiners of his theory were all protestants, especially Lutherans: **Rheticus and Rheinold** (both based in Wittenberg, Luther's home town), **Osiander, Maestlin, Kepler (1571-1630)**.



### Galileo and the birth of modern science

The birth of modern Astronomy in the West can be virtually dated back to **1609**, the year of the publication of the most important works by Kepler and **Galileo Galilei (1564-1642)**. It is also usually claimed that Galileo was the founder of the **scientific method** itself, although an exact definition of the latter can be the subject for long and complex discussions. As a matter of fact, while Kepler was still strongly influenced by metaphysical and symbolical schemes (e.g. his *Armonices Mundi* describes the Universe like divine Music), Galileo was not (apart from his metaphysical conception of Mathematics).

Even more important, **Galileo is the prototype of a modern scientist also from the social and professional point of view**.

He was born in a middle-class family, his father Vincenzo working as a wool trader to live while involved in musical theory and *production* (as an artisan and a composer). Interestingly, Vincenzo was very much interested in the *physical* mechanisms of sound production and their mathematical description. His empirical and critical mentality had a strong influence on the young Galileo. So the latter learnt to appreciate advanced instrument- and spectacle-making: **the telescope** came from Dutch artisans and was not his invention, but he knew how to profit from it. In fact, Galileo's figure is the one of a modern bourgeois scientist; his “selling” the telescope to the Venetian nobility and is famous conflict with the Roman clergy tell us a lot about **the advance of a new social class**.



### WHICH FUTURE?

Like nowadays scientists, Galileo learnt to be **promoter and popularizer of his own scientific work**. Therefore he preferred to write his *Dialoghi* in modern Italian (“*volgare*”) instead of using Latin: he aimed at the broader public of lower-class readers. In that epoch, in fact, several scientists arose from the lower classes - just craftsmen, people who could not even read Latin (e.g. **Joost Bürgi**). The same sort of self-promotion of Galileo is practised today by scientists. Individual success is uncertain like it was for Galileo – who was eventually defeated by the clergy. **Nowadays, the difficulties of the “struggle for science” have not disappeared at all**. In fact, chances for career as well as budget conditions do still depend on the more general social, historical, political context. And the attitude and interests of the ruling classes should be taken into account when we attempt to explain why the development and transfer of knowledge are sometimes impeded, or braked.

**NO “REFERENCES”, BUT JUST A FEW HINTS (let's limit to Italy and the UK):**

**Support Italian Research and Education**

<http://no-brain-no-gain.net>

**Adopt an Italian Astronomer**

<http://adoptitastronom.altervista.org/index.html>

**STFC Funding Crisis: Astronomy**

<http://pacrowther.staff.shef.ac.uk/stfc.html>

**UK government slashes funding for astronomy and physics**

<http://www.wsws.org/articles/2010/jan2010/cuts-j13.shtml>